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U. S. DEPARTMENT OF AGRICULTURE.

Clemson University



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R E P O R T

O F

THE FORESTER

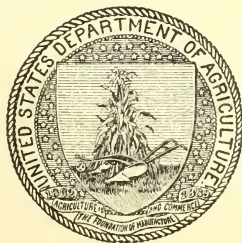
F O R

1912.

B Y

HENRY S. GRAVES.

[FROM ANNUAL REPORTS OF THE DEPARTMENT OF AGRICULTURE.]



WASHINGTON:
GOVERNMENT PRINTING OFFICE.
1912.

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REPORT OF THE FORESTER.

UNITED STATES DEPARTMENT OF AGRICULTURE,
FOREST SERVICE,
Washington, D. C., November 11, 1912.

SIR: I have the honor to transmit herewith a report of the work of the Forest Service for the fiscal year ended June 30, 1912, together with an outline of the plans for the work of the service for the current fiscal year and the fiscal year 1914.

Respectfully,

HENRY S. GRAVES, *Forester.*

Hon. JAMES WILSON,
Secretary of Agriculture.

CLASSIFICATION OF EXPENDITURES.

The appropriation act for the Department of Agriculture for the fiscal year 1912 made available for the Forest Service the following sums:

For statutory salaries.....	\$2, 318, 680. 00
For general expenses.....	2, 714, 420. 00
For improvement of the national forests.....	500, 000. 00

Total appropriation for Forest Service under the agricultural appropriation act.....	5, 533, 100. 00
Emergency fire-fighting fund appropriated for expenditure by the Secretary of Agriculture.....	1, 000, 000. 00

Available from other sources:

Federal cooperation (expenditures reimbursed by other Federal bureaus).....	\$569. 52
State and private cooperation (\$3,307.40 contributed by cooperators in 1912; \$3,977.71 brought forward from 1911; less \$93.32 returned to co-operators).....	7, 191. 79
	7, 761. 31

Total from all sources.....	6, 540, 861. 31
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At the close of the year there were unexpended balances as follows:

From appropriation salaries and general expenses.....	\$56, 061. 98
From appropriation improvement of the national forests.....	841. 45
From appropriation emergency fund.....	949, 412. 86
From unexpended cooperative funds (carried to fiscal year 1913).....	4, 325. 46
	1, 010, 641. 75

Amount expended.....	5, 530, 219. 56
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This total expenditure of \$5,530,219.56 paid the cost of administering, protecting, and improving the national forests and also of promoting the practice of forestry generally throughout the United States. The latter was accomplished through field and laboratory investigations, cooperation with States and private owners, and through activities for the diffusion of the knowledge reaped by investigations. Prorating among the several lines of work such general expenses as are incurred on behalf of the work of the Forest Service as a whole, and grouping the cost of these various lines according to the objects sought, the total expenditure may be subdivided as follows:

Administration and protection of the national forests-----	\$4, 718, 668. 96
Permanent improvements, national forests-----	499, 158. 55
Cooperative and investigative work and making known results--	312, 392. 05
	<hr/> 5, 530, 219. 56

There were also made under the direction of the Forest Service from other appropriations the following miscellaneous expenditures:

Examination of lands, titles, etc., under the Weeks law-----	\$113, 126. 79
National Bison Range, Mont-----	104. 98
Refunds to depositors, excess deposits (34 Stat., 1270)-----	47, 716. 54
Payments to States, 25 per cent of receipts from national forest resources for the fiscal year 1911-----	482, 376. 18
Cooperative fire protection under the Weeks law-----	44, 933. 53
Burial expenses men killed in fire fighting 1910-----	10, 972. 65
Reimbursement for horses, etc., lost fighting fire on national forests-----	2, 667. 90
Reimbursement to temporary employees for time lost on account of injuries sustained in fighting fire on national forests-----	5, 053. 67
Cooperative funds returned to contributors-----	93. 32
Total-----	<hr/> 707, 045. 56

The following statement shows the amounts paid to States to be expended for roads and schools from the national forest receipts of the fiscal year 1911 and the amounts that will be paid for the fiscal year 1912:

State.	Amounts paid fiscal year 1911.	Amounts payable fiscal year 1912.	State.	Amounts paid fiscal year 1911.	Amounts payable fiscal year 1912.
Arizona-----	\$55,385.62	\$61,614.42	Nevada-----	\$12,198.38	\$15,086.07
Arkansas-----	3,487.04	5,708.81	New Mexico-----	32,541.34	29,625.32
California-----	53,716.87	62,032.82	North Dakota-----	71.41	70.96
Colorado-----	52,372.26	53,759.07	Oklahoma-----	273.67	878.45
Florida-----	1,381.41	2,454.93	Oregon-----	35,612.30	42,559.52
Idaho-----	52,594.33	59,523.79	South Dakota-----	14,197.32	10,565.06
Kansas-----	919.10	1,224.64	Utah-----	34,869.10	33,760.42
Michigan-----	4.25	5.78	Washington-----	24,111.36	31,895.21
Minnesota-----	1,309.55	1,258.19	Wyoming-----	30,126.52	30,637.22
Montana-----	74,021.04	59,816.37			
Nebraska-----	3,183.31	4,075.89	Total-----	482,376.18	506,572.94

The appropriation act for the current year provided that 10 per cent of all national forest receipts of the fiscal year 1912 should be available for expenditure by the Secretary of Agriculture on roads and trails within the States in which the receipts were obtained. The amounts available under this provision are shown below. The

roads and trails to be constructed with these sums will be primarily for the benefit of communities.

State or Territory.	Ten per cent for expenditure for roads, etc.	State or Territory.	Ten per cent for expenditure for roads, etc.
Arizona.....	\$24,645.77	New Mexico.....	\$11,850.13
Arkansas.....	2,283.52	North Dakota.....	28.38
California.....	24,821.13	Oklahoma.....	351.38
Colorado.....	21,503.63	Oregon.....	17,023.81
Florida.....	981.97	South Dakota.....	4,226.02
Idaho.....	23,809.52	Utah.....	13,504.17
Kansas.....	489.86	Washington.....	12,758.08
Michigan.....	2.31	Wyoming.....	12,254.88
Minnesota.....	503.27	Alaska.....	4,675.48
Montana.....	23,926.55		
Nebraska.....	1,630.36	Total.....	207,304.65
Nevada.....	6,034.43		

The States of Arizona and New Mexico will also receive a percentage of the 1912 receipts for their school funds proportionate to the school-land sections within national forests. The amount of this is estimated at \$27,884.09 for Arizona and \$8,326.22 for New Mexico. The total amount payable to States or expendable within States for the benefit of their citizens from the national forest receipts of the last fiscal year is therefore \$750,087.90. The total amount of national forest gross earnings paid to the States in 1906, the first year in which any provision for payments to them of national forest funds was made, was \$75,510.19. The aggregate sum of all such payments to date is approximately \$2,850,000.

The share of the receipts which is now being paid over to the States from some of the forests is greater than the taxes which the lands would yield if they were entirely in private ownership. On the less developed forests the volume of use is still too low to make the returns to the States important; such forests would, however, yield little in taxes at the present time if they had never been set aside for national forest purposes.

As the great bulk of the timber, now too remote from transportation facilities to have a lumbering value, comes into demand the payments to the States will mount up rapidly. When a point is reached at which an equivalent of the total annual growth on the forests can be cut, the returns will be very large. It is shown later in the report that this possible annual yield is about 6,000,000,000 feet, which at the present stumpage rates would give a gross return of \$15,000,000. Of this, under the present apportionment of 35 per cent, including the 10 per cent for roads, the States would receive \$5,275,000 directly. Doubtless when the forests are self-supporting a new apportionment will be made. In addition it should be borne in mind that with the practice of forestry the returns will be permanently sustained, and that the lumber industries which will be occupied in manufacturing this annual product of the forest will distribute in the neighborhood of \$50,000,000 a year in wages. The States are even now receiving, without cost to them, substantial sums paid from gross receipts, while the heavy burden of administration and protection is borne entirely by the Federal Government. If the forests were owned and protected by the States the income now derived from them would instantly be

converted into a deficit. Only by abandoning all expectation of keeping the water, timber, and range resources of the forests permanent could a very large charge upon State funds be prevented.

During the past year there was made, in compliance with a requirement of the agricultural appropriation act for 1912, a classification of all expenditures of the Forest Service from the year 1900 to the year 1910, inclusive. The preparation of the statement called for by the law made necessary a line-by-line analysis of some 165,000 vouchers, covering the disbursement of over \$16,000,000. One result was to show that the net cost of the national forests to the Government for the six years 1905 to 1910, inclusive, counting in all overhead charges, but deducting the value of all property and improvements on hand, was less than \$600,000 per year. It was in 1905 that the Forest Service was put in charge of the national forests.

Against this net cost, as was pointed out in the report made to Congress embodying the results of the classification, must be set the public service rendered by protection and regulated use of the national forests, which at a very moderate estimate have a direct property value exceeding \$2,000,000,000. Even under the exceptionally trying conditions of 1910, in which the difficulty of fire control, the extent of the fires, and the loss caused by fires was far greater than in any other year, over 75 per cent of all fires discovered were put out by the forest officers without extra help or expense. The stock industry alone has benefited by regulated grazing to an extent far exceeding the entire net cost of caring for the forests. The yearly value of water protection by the Forest Service is probably greater than the entire annual appropriation for its support. The timber on the forests is advancing in value at the rate of not less than \$50,000,000 a year.

The summary of the classification of all expenditures and receipts for the 11-year period was shown as follows:

DEBITS.

(1) Total expenditures from Forest Service appropriations for forest work -----	\$16, 657, 759. 98
(2) Expenditures for printing and binding bulletins, circulars, etc., paid from departmental appropriation for printing and binding -----	236, 667. 60
(3) Payment to States, refunds, and other miscellaneous disbursements under the general direction of the Forest Service -----	1, 817, 753. 45
Total expenditure -----	18. 712. 181. 03

CREDITS.

(a) Receipts:

(1) From national forest resources (\$8,346,967.20 less \$208,844.51 collected by Interior Department -----	\$8, 138, 122. 63
(2) From miscellaneous sources -----	7, 358. 23
(3) From contributions for cooperative work with the Forest Service -----	109, 846. 63
	<hr/> \$8, 255, 327. 49

(5) Improvements and property on hand June 30, 1910:

(1) Permanent improvements other than equipment -----	\$1,864,226.63		
(2) Equipment and other nonexpendable property -----	636,816.40		
(3) Supplies and expendable property on hand June 30, 1910 (estimated) -----	96,325.08	\$2,597,368.71	
			\$10,852,696..20
Balance -----			7,859,484.83

Debit items 2 and 3 above, comprising as they do expenditures from departmental funds for printing and binding, payments to States from national forest receipts, and refunds of deposits, are of course not properly chargeable as expenditures by the Forest Service for its own work. The balance shown above includes both these items and disbursements from appropriations expendable only for purposes distinct from national forest administration, protection, and improvement. If all disbursements from appropriations available for the latter purpose had been used for this purpose solely, the net balance shown above would become \$4,321,655.01. In point of fact the net cost was less. The annual expenditures for administering, protecting, and improving the national forests (including that part of the cost of the Washington office fairly chargeable against national forest administration) were reported as follows:

Fiscal year.	Expenditures.	Fiscal year.	Expenditures.
1905 -----	\$509,186.68	1909 -----	\$3,554,896.03
1906 -----	953,999.67	1910 -----	4,351,152.55
1907 -----	1,538,419.31		
1908 -----	3,118,267.21	Total -----	14,028,921.45

If the balance is struck by deducting the credits tabulated above from this total, the entire net cost of national forest administration and protection since the Forest Service took charge becomes \$3,176,225.25, or under \$600,000 per year.

Among other facts developed by the classification may be mentioned the following:

(1) Out of the total expenditures of \$16,657,759.98 approximately \$8,000,000 was disbursed in salaries and wages for work on the forests, while over \$550,000 more was disbursed in salaries to persons engaged in the work of national forest administration and stationed in the districts but not on the forests.

(2) The total expenditure for salaries and wages of persons attached to the Washington office (though often employed in work outside of the city of Washington) for the 11-year period was not quite \$2,500,000. This sum covers the cost of general investigations, general administration, and inspection of national-forest work.

(3) Expenditures for travel during the entire 11 years was a little less than \$1,350,000, or 8.07 per cent of the total expenditures. This

includes all charges for transportation and subsistence of men on field trips, whether in connection with national forest administrative work, inspection, or investigative studies. In the years prior to the transfer of the national forests to the Forest Service travel expenditures ranged from 22.14 to 13.71 per cent of the total yearly expenditures. For the years 1905 to 1910, inclusive, the expenditures for travel ranged from 11.54 per cent in 1905 to 6.56 per cent in 1910.

(4) The expenditures for rent during the 11 years totaled a little less than \$330,000, or 1.98 per cent of all expenditures, of which slightly over \$145,000 was for rent in Washington and slightly less than \$185,000 for rent out of Washington.

(5) Classified under "Expenditures in Washington," "Expenditures out of Washington," and "Expenditures in and out of Washington" (i. e., freight and drayage, express, and telegraph charges on goods shipped or messages sent from or to Washington), the total expenditures for the 11 years, without deductions for repayments, were as follows:

In Washington-----	\$3, 292, 937. 62
Out of Washington-----	13, 126, 605. 45
In and out of Washington-----	284, 533. 92
Total -----	16, 704, 076. 99

(6) A statement of expenditures "for compensation of persons engaged in writing descriptive or other matter for publication" and "for lecturers" was required. It was shown that the cost of all work chargeable under these heads was relatively small, and that the general line followed in diffusing information was not materially different in character from that of other bureaus. The salary disbursements for persons employed partly or wholly in editorial work ranged from \$419.73 in the fiscal year 1901 to \$6,600 in the fiscal year 1910. No payments whatever were made to outside writers for the preparation of matter for publication by any outside agency, nor were any payments made to newspapers or magazines to secure publication of descriptive or other matter. No payments whatever were made, directly or indirectly, to procure the delivery of lectures by any persons not officially connected with the Forest Service, nor was a lecture bureau maintained in the service. So far as practicable, however, the service has always sought to diffuse information concerning its work and the results of its investigations by all legitimate means. To this end it has, at an insignificant cost, prepared and furnished information usable by newspapers along with the preparation of official publications, both technical and popular. The object sought has been throughout to bring about the better handling of forests all over the country.

The heavy burden and large cost necessary to compile the information set forth above would have precluded a demonstration of the facts brought out had the statement not been required by law. It is, however, a matter of no small importance that this exhaustive classification of expenditures has been made, since it affords a complete and precise demonstration of the use actually made of all appropriations during this entire period. Statements to the effect that the Forest Service has spent most of the money appropriated for it for purposes other than the care of the national forests; that it has main-

tained an extravagantly large force of office employees instead of doing field work; that its expenditures for travel, rent, and similar purposes have been excessive; that it has subsidized newspapers, magazines, or magazine and newspaper writers; and that it has maintained a lecture bureau or subsidized lecturers, are entirely disproved by a complete showing which covers all disbursements of the entire period.

The report in full upon these matters was published as House Document No. 681, Sixty-second Congress, second session.

ORGANIZATION AND PERSONNEL.

No important changes in organization were made during the year. The task was rather to strengthen the efficiency of the existing organization in handling all branches of work. In this direction there was a very definite accomplishment. The output of every unit in the service was materially enhanced. In 1911 the supervisory force in the national forest districts was very substantially reduced. The object was to effect economy and to determine by actual test the minimum force absolutely necessary for efficient supervision and inspection. The business of the service, however, is constantly increasing, so that the supervisory force was during the year strained almost to a breaking point. The result has been to show what is needed for the best and most economical organization. In several places additional help must be provided for adequate field inspection. The Forest Service is distinctly a field organization. Its work is very diversified and scattered over an enormous country, requiring a large number of men, with heavy responsibilities. The check on the work must come from field inspection. This is the only way to maintain adequate standards of individual efficiency. With a few changes and added strength to the inspection force at certain points, the present organization is able to handle the present volume of business. As the business increases, the organization must naturally respond to the new conditions.

The greatest attention was paid to the organization of the fire-protection work. The fundamental aim is to prevent fires from starting, but in case of fire to be prepared to meet whatever situation may arise. The present organization gives each supervisor a limited force of permanent statutory roll rangers, each in charge of a division of the forest. This force is increased during the dangerous fire season by the employment of temporary help as the conditions require and as far as the available money permits. The larger this force can be made during the fire season the better the protection. Normally there ought to be at least one patrolman to every 10,000 acres during the danger season where any serious hazard exists. The service actually employs about one man to each 60,000 acres. The force is not regularly distributed, the most men being placed where the hazard and property exposure are greatest.

The winter force has been reduced to the minimum necessary to maintain the framework of a permanent organization. This enables a greater expenditure during the season of fire danger. In working out this adjustment the presence of statutory positions acts as a dis-

tinct handicap, since it prevents an organization of sufficient elasticity to meet special and changing conditions in the best manner.

The results of careful organization of the protective force have been remarkable. Over and over again the men have been put to the test and met it with great credit. Careful planning, a closely coordinated organization of alert, capable rangers, and proper equipment for fighting fires have resulted in the ability to mobilize with great swiftness the necessary force to attack fire. With more trails and telephone lines and with sufficient funds to employ a larger force of guards where needed, under the special conditions of the season, the forests could be rendered very safe. Until these are provided the organization must be considered incomplete and the hazard of dangerous fires still uncomfortably great.

Special attention was also given during the year to the organization of the investigative work of the service. The broad and varied field covered by investigations, carried constantly into greater detail, necessitates a careful coordination of the various scientific activities of the service, in order to insure the utilization of all available knowledge and facilities for each project, to correlate all projects, prevent duplication, and to provide for taking the most important problems first and in the right way. These objects have been secured by constituting a central committee on investigative work, composed of one man from each of the three branches of silviculture, grazing, and products. This committee, supplemented by similar committees in the six districts, acts in an advisory capacity to the Forester in reviewing all scientific projects in advance, with reference to their practical purpose, relative need, cost, the avoidance of duplication, etc. The plan has resulted in very greatly increasing the efficiency and reducing the cost of the investigative work.

The plan of concentrating certain phases of the research work at laboratories and permanent experimental headquarters has been continued. Many problems requiring repeated and careful observations can not be conducted except through permanent stations. Already such stations exist on the Coconino, Pike, and Rio Grande National Forests. During the year two new stations were established—the Priest River Station, on the Kaniksu National Forest, in Idaho, and the Feather River Station, on the Plumas National Forest, in California. A third, the Utah Station, on the Manti National Forest, in Utah, was established after the close of the year. The Forest Service has also undertaken cooperative experimental work with the State of Minnesota at the Cloquet Forest Experimental Station, at Cloquet, Minn. This will secure information applicable to the management of the national forests in Minnesota and Michigan.

As is natural in any large organization, personnel changes are numerous. One of the most serious personnel problems is that created by the loss of experienced and valuable men who leave the service to accept more lucrative positions. During the year 23 experienced and well-trained men, holding positions of large responsibility, left the service for pecuniary reasons. This does not include the losses for the same reason among the rangers.

The number and classification of the forest force on June 30, 1912, was as follows:

Supervisors.....	147
Deputy supervisors.....	92
Rangers.....	1,393
Guards.....	780
Forest examiners and forest assistants.....	156
Lumber and mining experts, engineers, land examiners, hunters, etc.....	156
Clerks.....	171
Total.....	2,895

To facilitate administration various changes were made in the national forest units. In Oregon the Ochoco Forest was formed from portions of the Deschutes and the Malheur Forests; the Santiam, from portions of the Oregon and Cascade; the Paulina, from parts of the Deschutes, Fremont, Umpqua, Cascade, and Crater; and the Minam Forest, from a part of the Wallowa. In Washington the Okanogan Forest was formed by dividing the Chelan, and in Wyoming the Bridger and the Washakie by dividing the Bonneville. In Idaho the Selway Forest was formed from parts of the Clearwater and the Nezperce, and the St. Joe from parts of the Coeur d'Alene and the Clearwater. The Durango Forest in Colorado was formed from the San Juan; the Harney, in South Dakota, from the Black Hills, with an addition of 58,730 acres of new territory; and the Ruby, in Nevada, from the Humboldt, with 12,820 acres of new territory. The Garces Forest, in Arizona, was merged with the Coronado. The Choctawhatchee and the Ocala Forests, in Florida, were combined under the new name of the Florida National Forest. With these changes the forests at the close of the year numbered 163. The Luquillo Forest, in Porto Rico, is not under administration. It was found possible to continue as single units of administration the Tongass and Chugach Forests, in Alaska; the Toiyabe and Moapa Forests, in Nevada; the Manzano and Zuni Forests, in New Mexico; the Michigan and Marquette Forests, in Michigan; and the Dakota and Sioux Forests, in North and South Dakota and Montana. The average forest area was reduced from 1,070,545 acres to 1,003,700 acres. As business increases smaller units are needed. At the end of the fiscal year there were 157 forest units. These were in charge of 147 forest supervisors and 10 forest officers who were temporarily in charge pending appointment of supervisors.

At the end of the fiscal year 1912 there were 1,393 rangers on the forests, as against 1,424 at the end of 1911, a decrease of 31; and 780 temporary fire guards, as against 526 June 30, 1911, an increase of 254. This is for better fire protection by reducing the permanent and increasing the temporary force. The number of deputy forest supervisors was reduced by 8.

Temporary fire guards are appointed, to the extent permitted by the funds available, as the increasing risk of fire due to the oncoming of the fire season demands. The protective force is largest when the fire season is at its height. Owing to the fact that the act providing appropriations for the fiscal year 1913 did not become law until August 10, and that in the interval between the close of the fiscal year 1912 and that date, the period of normally heaviest ex-

penditures, there was available only a sum equal to the average expenditure of the entire previous year during an equal interval of time, it was necessary to postpone the enlargement of the protective force to its full strength until late in the season. On August 20, 1912, the total number of Forest Service employees on duty was 4,097, as against 3,541 on June 30. The increase was almost entirely in the forest force.

The Forest Service recognized at the start that its officers not only must be familiar with the regions in which they worked, but also must be in sympathy with the problems and interests of the people. An early provision of law required the selection of local officers, so far as possible, from residents of the States concerned. This has been scrupulously followed. Thus in case of the forest rangers, civil-service examinations are held only in the States in which national forests are located, and the regulations require that no nonresident eligibles be selected in any State or Territory as long as there is a register of resident eligibles. If, however, this register is exhausted, nonresident eligibles who took the examination within the State may be selected. Of the 1,393 rangers on the rolls on June 30, 1912, only 11 were appointees from the nonresident list.

The higher positions, like that of supervisor and district forester, are all filled by promotion from the position of ranger, forest assistant, or other positions in the service. When a vacancy in a supervisorship occurs the best available man, from the standpoint of proved ability, experience, and knowledge of conditions, is selected to fill it. The position may be filled either by promotion from the local force or sometimes by a transfer from another forest.

No one is ever put into an important executive position like that of supervisor, deputy supervisor, or the positions in the district offices, who has not had adequate practical experience in local conditions. The selection of men by promotion in the regular force absolutely guarantees this.

By an act of Congress approved March 11, 1912, the provisions of the act of May 30, 1908, under which compensation is made to employees of certain Government services who are engaged in hazardous duties, were made to apply to members of the Forest Service engaged in hazardous work. Under this law an employee so injured is entitled to receive for one year from the date of injury, unless such employee in the opinion of the Secretary of Commerce and Labor be sooner able to resume work, the same pay as if he continued to be employed. If death results within the year, dependent relatives of the degrees of consanguinity prescribed by the act are entitled to receive the balance of pay which would have been due for the remainder of the year.

THE NATIONAL FORESTS.

AREA AND BOUNDARIES.

The exterior boundaries of the national forests within the more important timber zones have assumed a fairly stable condition. It will take another year, however, to complete the boundary adjustments now under way. Their completion will, it is hoped, put practically all of the boundaries in a reasonably permanent shape.

Thirty-nine proclamations and Executive orders affecting the boundaries were issued. Two of these created interforest transfers between the Rainier and the Snoqualmie National Forests, Washington. One created the Devil Postpile National Monument within the Sierra National Forest, California. Two modified previous proclamations to permit of the selection of land by the States of South Dakota and Idaho. Eight Executive orders retransferred lands from as many national forests of Arizona, New Mexico, and California to Indian reservations. The remaining 26 eliminated 577,591 acres of land and added 153,414 acres. In addition to the reduction by these eliminations the national forest area was decreased by a retransfer of 2,497,840 acres of land to the several Indian reservations of which they originally formed parts.

These various readjustments in boundaries (together with the addition of 84,970 acres and the elimination of 364,820 acres effected by the 13 proclamations signed previous to the beginning of the fiscal year 1912, but which did not become effective until July 1, 1911, as stated in last year's report) effect a net reduction in the total national forest area of the United States of 3,201,867 acres. This leaves the gross area on July 1, 1912, under national forest control at 187,406,376 acres, and the net area at 165,027,163 acres, as shown by States in the following table:

National forest areas, in acres, by States.

State or Territory.	Gross area June 30, 1911.	Changes during fiscal year.		Gross area June 30, 1912.	Alienated.	Net area.
		Addi- tions.	Elimina- tions.			
Arizona.....	14,898,000		1,558,610	13,339,390	877,133	12,462,257
Arkansas.....	2,225,890			2,225,890	1,017,108	1,208,782
California.....	27,735,455	26,920	195,300	27,567,075	6,676,130	20,890,945
Colorado.....	14,761,900		26,440	14,735,460	1,458,089	13,277,374
Florida.....	674,970			674,970	366,560	308,410
Idaho.....	19,643,355		92,528	19,550,827	1,573,373	17,977,454
Kansas.....	303,937			303,937	148,201	155,736
Michigan.....	163,771			163,771	79,060	84,711
Minnesota.....	1,204,750			1,204,750	358,123	846,627
Montana.....	19,305,100		241,330	19,063,770	2,936,412	16,127,358
Nebraska.....	556,700			556,700	35,795	520,905
Nevada.....	5,650,347	83,155	177,992	5,555,510	260,891	5,294,619
New Mexico.....	11,111,300		937,410	10,173,890	1,354,482	8,819,408
North Dakota.....	13,920			13,920	7,506	6,414
Oklahoma.....	61,640			61,640	160	61,480
Oregon.....	16,148,900		125,480	16,023,420	2,364,741	13,658,679
South Dakota.....	1,287,700	67,730	17,680	1,337,750	180,866	1,156,884
Utah.....	7,667,585	60,579	7,081	7,721,083	433,367	7,287,716
Washington.....	11,684,680		320	11,684,360	1,848,214	9,836,146
Wyoming.....	8,693,543		0,080	8,693,463	264,440	8,369,023
Total, United States	163,793,413	238,384	3,440,251	160,591,576	22,240,648	138,350,928
Alaska.....	23,748,850			26,748,850	105,590	26,643,260
Porto Rico.....	65,950			65,950	32,975	32,975
Grand total.....	190,608,213	238,384	3,440,251	187,406,376	22,379,213	165,027,163

EXCHANGE OF LANDS.

On February 15, 1912, the President signed a proclamation carrying into effect an agreement entered into January 4, 1910, between the Forester, on behalf of the Department of Agriculture, and the State of South Dakota, providing for the exchange by the State of

school lands within the then Black Hills National Forest for other lands equivalent in acreage and value lying along and within the boundaries of the national forest. The area involved in the agreement amounted to 60,143.92 acres. To satisfy the State's equity the proclamations affecting the Harney and the Sioux National Forests were modified to permit the State to select 47,937.65 acres from the Harney Forest and 12,206.27 acres from the Sioux.

A similar proclamation was signed June 4, 1912, completing an agreement entered into July 10, 1911, affecting the St. Joe National Forest, Idaho. There is also now under way an examination of the unsurveyed school sections within all the national forests of Idaho in conformity with an agreement entered into by the State and the Department of Agriculture on October 4, 1911, whereby the State is to relinquish its claim to the unsurveyed sections within the several national forests and select in lieu thereof one or more areas lying along and within the present boundaries of the national forests, equivalent in acreage and value to the lands surrendered.

The act of March 4, 1911 (Public, No. 513), authorized the Secretary of the Interior to exchange desert lands therein described for lands owned by the Portland Land Co. within the national forests of Oregon. In accordance with the provisions of the act an examination was made by the Forest Service of the lands to be reconveyed to the United States and a recommendation that the exchange be made has been forwarded to the Secretary of the Interior.

Under provisions of the act of February 28, 1911 (37 Stat., 960), Messrs. G. W. Finnup and James Cowgill made application for the exchange of private lands within the Kansas National Forest for other lands within the national forest. Both applications were approved and forwarded to the Secretary of the Interior.

Other exchange projects are under way. The governor of Montana has expressed a desire to enter into an agreement similar to the Idaho agreement for the exchange of the Montana school lands for national forest lands. A bill is pending in Congress looking to the exchange of State and Government lands in Michigan. Several other less important applications for exchanges made by companies and individuals are pending. The basis of these various negotiations is the exchange of lands approximately equal in acreage and value.

The advantages of such exchanges of land both to the States or individuals and to the Forest Service scarcely need pointing out. The States will in each case secure valuable areas of land in compact form in lieu of scattered sections. This will enable them to secure a greater revenue from the areas both by State management of the timbered lands and by more advantageous leases of the grazing areas. The Forest Service benefits from such exchanges principally because it is advantageous from an administrative standpoint to have the national forest units as solid as possible.

In view of these mutual advantages opportunity for similar exchanges both with States and with individuals will be sought. Other States may eventually find it desirable to effect such exchanges. No need exists for exchanges in Arizona and New Mexico, as the enabling acts of these States provide for the administration of the school lands within the national forests by the Forest Service, the State receiving a pro rata of the receipts.

The agreements for exchange have so far applied only to school sections which were unsurveyed at the time of the creation of the national forests. This is because there is some doubt as to the power of the State to exchange sections to which it had acquired absolute title prior to their inclusion within the forest. This doubt should be removed by congressional action. Several bills have already been introduced in Congress for this purpose, but so far have not received favorable consideration.

CLAIMS AND SETTLEMENT.

Aside from the perfecting of claims initiated before the forests were proclaimed, further reductions in net area through private acquisition of lands within the forests can, under existing laws, take place only (1) through new mining claims, and (2) through agricultural settlement on lands listed by the Secretary of Agriculture in accordance with the forest homestead act.

MINING CLAIMS ON NATIONAL FORESTS.

Mining claims are perfected and new mining claims initiated under the same laws which apply on the unreserved public domain, and no restriction of any kind is imposed on the prospector in his search for valuable minerals. He may go freely where he pleases and may stake out his claim wherever he finds indications that seem to him worth following up. If he desires to build a cabin on Government land not included within the limits of his claim, he is given a free occupancy permit and free timber for its construction. On his own claim he need only comply with the law to remain in undisturbed possession for as long a time as he may desire before making final proof. Both the timber and the forage on it are reserved for his use, in so far as he may need either in connection with the development of his claim; and if the supply on his own claim is not sufficient for his needs, free use of national forest timber, and of range for his work animals, may be had for the asking. When he desires to make final proof no requirements are imposed upon him other than those laid down by the general mining laws for all public lands. Moreover, by the protection which national forest administration affords against fire and by the provision made for permanence of timber supplies for local needs, he gains both in security against fire loss and in insurance against the danger of having to bring timber from distant markets at a heavy cost in order to work his mine.

Yet the charge is frequently made that the national forests are closed to mining development and that restrictions have, without legal warrant, been imposed upon the patenting of mining claims within them.

In so far as these charges are not the result of misapprehensions or misrepresentations, they arise from the fact that before claims to land within national forests are patented they are examined by forest officers, and reports upon them are submitted to the Interior Department, which has sole jurisdiction over all questions of land title. These reports are made in accordance with the request of the Secretary of the Interior. Doubtful claims bearing evidence of fraud or

failure to comply with the requirements of the mining laws are always examined on the ground by a practical miner or mining expert, and adverse recommendations are made only when such officer certifies to the malefices of the case.

In reporting upon mining claims the question first considered is whether the patenting of the claim will in any way affect adversely the interest of the public in the land for national forest purposes. If the claim is not located on land which is valuable for its timber or of high value for purposes other than mining, and if it was apparently taken in good faith for mining purposes and the mineral laws have been complied with, the claim is reported upon favorably as not prejudicial to national forest interests, leaving further consideration of it to the General Land Office on the basis of its customary requirement of proofs in the form of affidavits offered by the claimant and his witnesses.

When, however, the examination of the land by a forest officer develops the fact that a public interest is involved because of the value of the land for national forest purposes—that is, for the preservation or permanent production of timber, the protection of water flows, use for water-power development or some other form of occupancy under special-use permit, or public use—a favorable report is made to the Land Office only after it has been examined by a mineral examiner of certified civil service standing or by a practical miner competent to pass upon the questions involved. Adverse reports of the ground that the requirements have not been complied with (the only ground, of course, on which any claim is ever reported adversely) are never made unless the claim has been examined by a mineral examiner or practical miner. Further, before an adverse report is transmitted to the Land Office the showing of facts made by the examiner is scrutinized, with reference to the evidence submitted and the law involved, by the district assistant to the Solicitor of the Department of Agriculture; and only if this officer is satisfied that the evidence offered is sufficient to prove failure to comply with the mining laws is the Chief of Field Division of the General Land Office notified that the Forest Service desires to protest the claim.

Such notification is in no sense a rejection of the claim. It merely places before the Land Office the facts as found upon the ground by the examining officer and the conclusions which the Forest Service believes to be warranted by them. The Commissioner of the General Land Office decides, with the evidence before him, whether a hearing will be ordered. His action is necessarily largely influenced by the recommendation of the Chief of Field Division, but is, of course, subject to review by the Secretary of the Interior.

The General Land Office is, under the laws of Congress, a land court. The objectors to the present procedure practically deny the right of the Government to appear before that court on behalf of the people of the United States, as against a private claimant to mineral lands, in order to introduce evidence of noncompliance with the law under which the claimant seeks title. It is alleged that because the Department of Agriculture is not refused the right accorded any private citizen to seek cancellation of a claim thought to be illegal when an adverse interest exists, the mining industry is oppressed and a bureaucratic despotism is permitted to overthrow and displace the law.

To deny the right of the public to its day in court would be to open the door to frauds of every conceivable character. It is an undeniable fact that there is a great deal of very valuable land in the national forests. Land valuable for agriculture is open to entry upon regular classification. The requirement of prior classification makes it impossible to use the forest homestead law as a vehicle for fraud. No such restriction is placed upon mineral entries; the final report made upon these claims is the only barrier to securing under the mineral laws, by means of false representations, patent to lands of large value for other purposes.

The system of requiring reports on each claim before patent issues is necessary to preserve the integrity of the national forests, and is no less necessary to the preservation and good standing of the mining industry itself. Cases are frequent of "wildcat" companies seeking to patent extensive areas of land barren of mineral or other value for no other purpose than that of deceiving the innocent investor. In such cases the patent issued by the Government is submitted as proof of the value of the land, and investments are made based upon the belief that the Government has required of the promoters a fair compliance with the law. A system which meets with bitter protest and vilification from such "wildcat" operators surely performs a duty to the public, and is the friend of every legitimate mining enterprise.

But the foregoing is only one of many classes of frauds which are attempted under the guise of the mining laws. In every case the real miner is the victim rather than the beneficiary. In very few instances are doubtful operations promoted by practical miners or prospectors. A few recent examples will serve to illustrate this very important fact.

A supposedly rich mineral strike was made in one of the national forests, and there was a great rush of people to that vicinity. Indications were favorable to the establishment of a permanent gold mining camp, and immediately people interested not directly in mining, but in other related enterprises, flocked to the vicinity of the new strike and began to establish settlements and places of business. Owing to the topography of the country there was only one favorable place for establishing a town, and this place was immediately covered by mining locations. These mining claims were thereupon placed in the hands of professional town-site boomers, who surveyed the land off into building lots under the guise of mining leases, which leases carried an option of sale. By distorting the purpose of the mining laws to suit their special case these speculators were enabled to retard, but not actually to prevent, bona fide settlement and the establishment of business much needed in connection with the mineral development of the country. It came out in the proofs regarding this case that the leveling done by the holders of these mining leases, who in fact were the actual purchasers of the ground, was construed by the town-site speculators as mineral development, as was also the grading, and the digging of cellars, etc. The worst feature was that there was no means whereby the purchasers of these lots could secure an actual title to the land purchased, the deeds being only quitclaim deeds carrying no further obligation on the part of the town-site company or the locators of the claims. There actually exist in Nevada, at the present time, town sites portions of which are upon mining locations the validity of which can probably never be established, and the holders

of the quitclaim deeds for the surface of these claims will never be able to acquire actual title to the land until the mining claims are held to be invalid and the residents enabled to proceed to secure title to their holdings under the town-site laws. Here the town-site boomer misused the mining laws.

In another instance a large live-stock company purchased the majority of the stock grazed in a certain section of the country splendidly adapted for cattle range, except that water was scarce, the only available supply consisting of small lakes or ponds and small springs. This cattle company, in order to establish a complete monopoly of the range, proceeded to put mining locations and mill sites upon all the watering places, with the exception of two or three which were covered by scrip location. No mineral development was, however, attempted on any of these claims. The locations were upon formations containing no mineral showing whatever, and alleged development work consisted of tunneling and trenching for the collection of water and in the building of corrals, tanks, and pipe lines for the handling and watering of the cattle. In this way water holes were secured which gave control of approximately 500,000 acres of valuable range. Here the cattlemen misused the mining laws where there was no one to protest or report.

In another instance a sheepman was occupying and grazing a certain section of range within a national forest in a country mineralized to some extent, and in which the water supply was limited. Some old placer diggings existed in a certain canyon within the vicinity of a small spring, which placer diggings had been abandoned for years, with the exception of the fact that some Chinamen, when out of anything else to do, would occasionally work the claim for what they could get out of it. The sheepman proceeded to locate a mining claim covering the spring and the old placer diggings, established a shearing or dipping corral, and applied for patent to the ground, claiming as his \$500 worth of development the work done by persons who had abandoned the claim as not of sufficient mineral value to be worth further consideration, and work done by the Chinamen mentioned. Here the sheepman attempted to misuse the mining laws.

Another illustration is a case in which a large power company attempted to procure title to a valuable power site by locating mining claims extending up and down the stream upon which the plant is located. These locations were placer locations and the mineral alleged to exist in the claims was asserted to be lime, and the claims were known as the Limestone Placers. A Government expert made examination of these claims and submitted an adverse report. Here the hydro-electric power company misused the mining law.

Not far from this last-mentioned case some individuals made application for the patenting of some placer locations, alleging the existence of valuable minerals. The location happened to be within a national forest, and, under the regulations of the two departments, the Forest Service made an investigation in connection with a representative of the General Land Office, and the following facts appeared: There was no showing of mineral whatever upon the locations except a sort of shale, which the locators alleged had some value for cement making. In the application of the patent the locators

alleged that \$1,500 worth of work had been done. Investigation showed that all the work that had been performed was in grading for driveways and for building locations, and that it actually amounted to less than \$300 at a liberal estimate. It further developed that the locators had incorporated a company for the exploitation and sale of building sites for summer homes, this location being in the mountains, within easy reach of a thickly populated section of country, and directly on an electric car line leading from a city of considerable size. Here the dealer in suburban summer homes sought to misuse the mining laws.

Not long since a large mining company, operating mines just upon the border of one of the national forests, applied for the purchase of a tract of timber situated within the forest, desiring and in fact being in actual need of the timber in its mining operations. The local forest officer proceeded with the usual preliminaries necessary in making a sale. While he was doing so it became known in the neighborhood generally that the mining company was making a purchase of the timber on a certain tract of land; whereupon some individuals immediately proceeded to the tract and placed thereon mineral locations, alleging the existence of valuable minerals, and endeavored to compel the mining company to pay them as well as the Government for the timber. Failing in this plan of extortion, the locators abandoned the claims, admitting that all they wanted was the timber. Here the grafter tried to misuse the mining law and exact tribute from the miner.

In a California case an effort was made by means of mining locations to secure control of the most valuable and important bodies of timber in one of the national forests. One man, with the aid of two or three others and the use of the names of others, covered thousands of acres of valuable timber land by means of placer locations. The report by Government experts and the decision of the Commissioner of the General Land Office held the claims to be invalid because of insufficiency of discovery and the absence of showing of valuable mineral deposits. Here the timber grabber tried to misuse the mining law.

The men who engage in mining as a legitimate permanent industry have no incentive to evade the law, since they are not limited as to the time within which they must apply for patent but are at liberty to develop the ground and extract the mineral to any extent, subject only to the mining laws of the State. The miner has no trouble in applying for patent under the mining laws for ground chiefly valuable for mineral. The man who has trouble is the man who tries to secure, under cover of the mining laws, a town site, a summer resort, valuable timberland, a water-power site, watering places in the desert, or mineral springs in the mountains. Such frauds, in no sense connected with the mining industry, would thrive and multiply if mining claims were not reported upon before being passed.

Whether or not legitimate mining development has been handicapped by the examinations made in the years since the making of such examinations began may be judged in the light of the fact that more than four out of every five of the claims examined during the entire period have been reported upon favorably.

The present procedure is on all fours with that followed by the Interior Department with respect to land withdrawals by the Gov-

ernment for other than national forest purposes, on which all claims are investigated by the department before they are allowed to go to patent, except where an election to take surface title is filed in cases covered by the act of March 3, 1909 (35 Stat., 844), and the only question involved is the coal character of the land.

When mining claims which appear to be invalid interfere with national forest administration, it becomes necessary for the Forest Service to apply for their cancellation by the Interior Department. In making such application the Forest Service merely exercises the same right which the law gives any private individual to contest a claim which does not conform to the law before patent is applied for. Except for such cases, the question of the validity of claims is raised only upon notification to the Forest Service by the General Land Office that patent is sought by the claimant.

Under existing laws the Forest Service is powerless to protect permittees who are allowed to occupy national forest lands for water-power development and other purposes against the location of mining claims upon the areas covered by their permits. It is exceedingly desirable that legal recognition should be given to the principle of highest use in such cases. Mining use does not necessarily preclude other forms of use, nor is there any inherent reason why the locator of a mining claim on public land should be given any right upon the surface of his claim beyond the right to make such use of it as is required for mining development. It would be entirely practicable to provide for simultaneous development of more than one resource without permitting the developer of any resource to levy tribute upon another for privileges which he does not need.

ACTION UPON CLAIMS OF ALL KINDS.

Field examinations of claims furnished a basis for reports to the General Land Office as follows:

Reports to the General Land Office on unpatented claims.

Character of report.	Home- stead.	Desert land.	Timber and stone.	Mineral entry.	Coal entry.	Miscel- laneous.	Total.
Favorable.....	737	24	27	718	18	10	1,534
Unfavorable.....	147	6	2	144	8	28	335
Total.....	884	30	29	862	26	38	1,869

Action upon claims to national forest land before the Department of the Interior resulted as follows:

Claims to national forest land disposed of by the Department of the Interior.

Character of action.	Home- stead.	Desert land.	Timber and stone.	Mineral entry.	Coal entry.	Miscel- laneous.	Total.
Patent issued.....	903	11	139	901	20	14	1,988
Canceled.....	407	11	27	220	26	37	728
Total.....	1,310	22	166	1,121	46	51	2,716

AGRICULTURAL SETTLEMENT.

NEED FOR SETTLERS IN THE NATIONAL FORESTS.—The Forest Service has always recognized the importance of agricultural development of all lands within the national forests which will make the largest returns to general prosperity under cultivation. It has also desired and steadfastly sought that such lands be given to home seekers as freeholds on condition only of bona fide homesteading. It was for this reason that the forest homestead act of June 11, 1906, was introduced at the request of the Forest Service and its passage strongly advocated.

The forests were established in order that their resources might be developed and used in a way to contribute in the greatest measure to the public good. The fundamental aim, as interpreted by the Forest Service, is to put to its most productive use every foot of land in the forests. Those areas most valuable for agriculture are to be used for that purpose; those most valuable for mining to go to the miner; those most valuable as water-power sites or for irrigation to be put to such use, and so on. There can be only one way to accomplish this development, and that is to get farmers on the farm land, miners to prospect and develop mines, water-power companies to build construction works, lumbermen to buy timber, stockmen to put in their herds to feed on the grass. In other words, people are needed in the forests to use the resources. Furthermore, the greatest single task of the Government is to prevent forest fires. That is fundamental to the purpose of producing timber. The service has its organized force of rangers and guards, recruited largely from those living in or near the forest, for it is these men who know the conditions and know how to fight the fire menace. But in addition to the organized regular force the service must have a second line of defense in case fires start. With settlers scattered through the forest assistance is secured in locating fires. Telephones are attached to the ranches and word is sent by the settlers to the forest officers. In case of need the settlers help in putting out the fires. It is to the settler also that the service turns for labor on a great deal of the work of building roads, trails, and other improvements. In short, the plan of development of the forest by the Government requires exactly what the settlers can give; hence there is a powerful reason for opening up agricultural land for these purposes as well as for the best economic development of the country.

CHARACTER OF AGRICULTURAL LAND IN THE FORESTS.—The national forests are located in the mountains. They include the highest and most rugged portions of the Rocky Mountains, the Sierra Nevada, and the Cascade and Coast Ranges. Their boundaries were drawn to comprise land suited to tree growth and for water protection. The large bodies of agricultural lands in the foothills have been excluded. Therefore most of such agricultural land as occurs is located along the narrow valleys of the mountain rivers and streams and on occasional benches, coves, and swales, where soil has collected and the topography and climate permit cultivation. A great deal of the best land, except areas under heavy timber, has already been taken up; some of it before the creation of the forests and some under the forest homestead law. There are only a few areas containing solid blocks of agricultural land of any extent, and these are in nearly all cases covered

with very heavy timber. Most of the agricultural land left in the forests is in small scattered units.

The larger areas of agricultural land still covered with heavy timber are mostly situated in the forests of northern Montana, Idaho, Washington, and Oregon. These areas will be cut over as rapidly as possible and then opened to entry. On portions of the above-mentioned land the soil is exceedingly good and should make productive farms.

Another group of lands of agricultural possibilities occurs in the semiarid Southwest. There are some bodies of land at the base of the mountains which are suited topographically and by soil for agriculture, but water is entirely lacking. They can hardly be called agricultural at present, for water is quite as important an element in soil as nitrogen or any other chemical constituent. If water can be found these lands will be promptly classified as agricultural and opened to entry.

The rest of the agricultural land in the forests is in small units. The home seeker finds that the best open meadows and swales, the best flats at the confluence of streams, and the benches presenting the easiest conditions of cultivation have already been for the most part taken up. There remain still many scattered plots less accessible to existing roads, higher in the mountains and with less favorable climate, which are susceptible of cultivation. But the prospective settler must not expect to find a Sacramento Valley in the high Sierras nor a Willamette Valley in the high Cascades.

The statement has been frequently made by opponents of national forestry that settlers are leaving the country for Canada because the national forests are practically closed to settlement. In the first place, the national forests are not practically closed to settlement, so far as there is agricultural land in them; but the real reason settlers go to Canada is because there is more vacant land there of the kind they seek. A man seeking wheatland and flat farming prefers Canadian land of this character to a mountainous tract with uncertain conditions of transportation. It is the difference in conditions that takes men to Canada. Agricultural lands simply do not exist in the national forests which can compete in quantity and quality with the Canadian wheat fields, just as no settler would go up 6,000 feet in the Rocky Mountains for a strip of aspen land if he could get a free farm in North Dakota.

The total amount of agricultural land in the national forests not yet taken up will aggregate about 4,000,000 acres, of which a large amount is under heavy timber. The statement that there are many million acres of agricultural lands in the forests not under merchantable timber is contrary to the facts. While the exact figures will not be available until the classification of lands now in process has been completed, the data above given are based on careful estimates by the individual forest supervisors, from their knowledge of local conditions, and are liberal. One illustration may be taken from the work done by the Forest Service and Idaho Land Board in their classification of State school land in Idaho, looking to an exchange with the Government. The school sections are scattered evenly through the forest. So far, 375,000 acres has been jointly classified, and only 1 per cent has been found to be nontimbered agricultural land.

PRIVATE LANDS IN THE FORESTS.—Many persons have been misled by the presence of private lands in the forests. It frequently happens that persons passing through a forest see a great deal of good agricultural land lying undeveloped and assume that because it is within the boundaries of the forest it must be Government land, when in point of fact it is privately owned. This has led to public statements about the amount of undeveloped agricultural land in the forests, which proved to be untrue, because the land referred to was actually in private ownership. For years the general land laws were in operation, and at the time of the establishment of the forests large timber interests were amassing tracts of enormous size and value. About 90 per cent of the western white pine in Idaho and Montana—the most valuable tree of the Northwest—is owned by private timber companies. A considerable part of this lies within the national forests. The timber companies aimed to secure the heaviest timber. Naturally this occurs on the best soils. Moreover this private land is usually the most accessible to transportation.

PRIVATE OWNERSHIP OF TIMBERLAND RETARDS AGRICULTURAL DEVELOPMENT.—The history of homesteads in heavily timbered regions of the West has been that actual agricultural development has occurred where the entryman had as a starting point a stretch of open land such as a meadow or an area cleaned by some old fire. Heavily timbered tracts have promptly passed into the hands of timberland owners or are held by the entryman for timber speculation. The reason for this condition is obvious. The timber has an actual tangible value for speculative purposes. The entryman is able to sell out and realize a very substantial sum from a timber concern, or if he is strong enough he can himself hold the timber for the increased value which is certain to come. On the other hand, to clear the land and destroy the timber means infinite hand labor, representing a cash cost of from \$75 to \$250 per acre, according to the amount and conditions of the stand of timber. The inevitable result has been acquisition of most of the timber by timber companies and timber holders.

The most conspicuous example of this principle is found on the Olympic National Forest, concerning which details were given in my report for 1910. Precisely the same result has occurred in other timbered regions. A careful analysis of all timbered homesteads located in the Kaniksu Forest prior to its withdrawal, 95 in all, showed that only 1.34 per cent of the cultivable land has been put to agricultural use. A similar examination of 71 claims in the Clearwater National Forest of Idaho showed that 1.1 per cent of the claims had been cultivated.

The effect on agriculture of private ownership of timberlands is here very clearly shown. The timber owner holds the property until he is ready to cut or until the values have risen to a point which induces him to sell. The lands are then logged and the owner offers them for sale at such competitive prices as he can secure. The policy of most companies has been to go rather slowly in selling their lands. Recently public pressure has forced many companies to establish land departments to dispose of the agricultural land. The prices obtained range from \$10 per acre up. In this process the settler is not helped. The land lies undeveloped until the company is ready to cut the timber. The settler then has to pay a big price for the land. The

well-to-do farmer can pay this price, but the home seeker with no money even for a small cash deposit is excluded. Laws made for the benefit of this very home seeker result in excluding him altogether and permitting the timber speculator to acquire resources of enormous value from the Government for speculative purposes.

It is this condition which has led to the policy of the Forest Service to cut over the heavily timbered tracts before opening them to entry, in order that settlement may be hastened and the bona fide settler may get his land free.

WHAT LAND HAS BEEN OPENED TO ENTRY.—The Forest Service has been steadily segregating and listing for entry the lands in the national forests that are chiefly valuable for agriculture. Between the time that authority to list was granted in 1906 and June 30, 1912, there was listed a total of 1,144,359 acres to the benefit of over 12,000 settlers. In the first four months of the current fiscal year this amount has been increased by 68,665 acres more. The nearly 10,000,000 acres eliminated from the forests during the last three years also contained a great deal of agricultural land.

Where land is found suitable for dry farming it is segregated and opened to entry. If irrigation is required, land of good soil is listed wherever there is a possibility of developing water. In the case of agricultural land now covered with heavy timber far exceeding its value for farming, listing of which would invite timber speculation rather than bona fide settlement, the timber is removed by sale and the land then opened to entry. Some of the timbered lands contain from 20,000 to 75,000 feet per acre, worth from \$2 to \$5 a thousand on the stump.

Where land is chiefly valuable for water-power sites, irrigation reservoirs, or purposes which would lead to the monopolistic control of natural resources it has been retained under public control. Lands needed for public purposes, such as administrative sites, logging landings, mill sites, etc., have also been retained by the Government.

PROBLEM OF RIGHTS OF WAY.—The problem of reserving rights of way for public uses has presented many difficulties. A large number of tracts which are opened to agricultural entry are so located that they control the rights of way over which national forest timber must be brought to market or command the only way to private timber and to agricultural tracts. This is especially true because so much of the agricultural land in the national forests occurs in strips along narrow valleys and gulches. In many of the tracts which were first opened to entry this condition was not foreseen, and no provision was made for a reservation of a right of way. Already difficulties of this kind have arisen. The only way under the present law of meeting this situation is to survey out in advance the right of way and describe it in the patent. This is very costly and, furthermore, it is unsatisfactory, because it is often impossible to tell in advance just where the needed right of way will be required. There is, therefore, urgent need of general legislation authorizing the Secretary of the Interior to express in all patents the reservation of rights of way for governmental purposes and the need of settlers.

LAND CLASSIFICATION.—For several years after the passage of the forest homestead act examinations of agricultural lands were made only upon application; that is, when a specified tract was desired by

some one who wished to take advantage of the law. While the desirability of a general classification on the initiative of the Forest Service was recognized, the urgent demands on all available funds, created by the necessity of protecting from fire the vast public resources embraced in the forests and the further necessity of providing for the transaction of business involved in their use, operated to defer the inauguration of this large new task. Furthermore, nontimbered agricultural lands in the forests are in scattered areas and can be located only through a large number of individual examinations dealing with small units. Where relatively large nontimbered areas suitable for agriculture occurred they were usually dealt with not by considering them for listing, but by eliminations through presidential proclamation. As already explained, the 10,000,000 acres so far eliminated comprised a great deal of such land. Systematic classification of the agricultural lands was begun in 1909, and a great deal of progress has already been made, particularly in northern Montana. This work was not extended to all the districts until the present year. A more comprehensive plan of work was approved by the Secretary of Agriculture in April, 1912, and plans were immediately initiated for the field season then opening. By June 30, the end of the fiscal year, the classification work was in full progress in four of the six districts—1, 2, 3, and 6. Under this plan the agricultural lands are to be classified in each forest and full data secured concerning the character of the soil and other conditions bearing on their suitability for agricultural development. In order to secure authoritative data as a basis for the classification the cooperation of the Bureau of Soils has been secured. The Bureau of Soils furnishes for the work a number of its best field experts. It was recognized that such questions as the depth and character of the soil, whether irrigation is practicable or whether crops can be raised without irrigation, whether the altitude and climatic conditions are such that crops will mature, and whether the slopes are so great that there is material danger of erosion, should be passed upon by specialists in agriculture.

The greatest obstacle to the carrying out of this work was the lack of funds which could be used without seriously curtailing or stopping other important work. This is true in spite of the fact that in the long run such a classification would be much more economical than to continue under the old plan. It would also meet the urgent demand of the settlers who wish to secure homes within the forests. A Senate amendment to the agricultural appropriation bill for the fiscal year 1913 provided an appropriation of \$50,000 for the classification of agricultural lands, and thus opened the way for carrying forward the classification work more rapidly. The amount carried by this amendment was reduced in conference to \$25,000. In its original wording this amendment provided for the classification of lands "suitable and fit for agriculture"; the House conferees, however, caused such a rewording of the amendment as to insure the retention of the principle embodied in the act of June 11, 1906, which prevents the opening to entry of lands having greater value for their timber or other forms of national forest use than for agriculture, and of lands needed for public purposes.

The agricultural appropriation act became a law on August 10, 1912. The work of classification, greatly enlarged, is being pushed with all possible vigor.

LANDS LISTED DURING 1912.—The results of the year under the law of June 11, 1906, are shown in the following table:

Applications and listing for forest homestead entry.

Fiscal year.	Number of applications during year.	Awaiting final action at close of year.	Number of tracts listed during year.	Acreage listed during year.
1912.....	5,100	3,135	2,063	215,848
1911.....	5,349	2,984	2,962	311,306

While there is always an accumulation at the close of the fiscal year of applications awaiting action because they were made during the winter months, when field examinations are in most regions impossible, the number of such applications shown above was unusually high for special reasons. Of the total 3,135, almost one-half, or 1,418, were pending in the office of the district forester at Missoula, Mont. Of these, 140 are within a railroad grant and can not be acted on until public survey has been extended; 125 are for what are known as "jack-pine flat" lands, of sufficiently doubtful agricultural value to justify an exhaustive investigation now under way by the Bureau of Soils; while 302 are for heavily timbered lands in several Montana valleys. The soil in these valleys is considered valuable for agriculture, but when areas applied for support very heavy and valuable timber it is necessary to suspend action until the timber can be removed if actual use for agriculture, not withholding from use for purposes of timber speculation, is to be brought about. A number of other applications have been suspended pending the general classification of the forests in which they are located.

THE SURVEY OF CLAIMS.—The preliminary survey under which land is listed for settlement under the act of June 11, 1906, is made at the expense of the Government, but when the entryman comes to make final proof he must file a plat and field notes of a survey of his claim made under direction of the surveyor general. This adds an expense of from \$100 to \$200 which the settler must bear, and in most cases is a duplication of work. Under a cooperative plan recently effected between the Department of the Interior and the Department of Agriculture, the original survey will be made under direction of the surveyor general by a forest officer designated by him, and the settler will be relieved from additional expense.

The act of August 10, 1912, made an appropriation of \$35,000 for the survey and listing of agricultural lands by metes and bounds under the above-mentioned plan, and provided that no land listed under the act of June 11, 1906, shall pass from the forest until patent issues. This will encourage settlement by removing the obstacle of the cash outlay heretofore necessary to secure patent to the lands, and will place all settlers within the national forests on an equal basis so far as the cost of survey is concerned.

LANDS WITHDRAWN AS ADMINISTRATIVE SITES.—It is sometimes said that agricultural development of national forest lands has been unnecessarily blocked by excessive withdrawals of land for administrative use. Both proper protection of the forests and adequate pro-

vision for their business needs call for the reserving of such areas as will be needed for public purposes. These include not only headquarters for rangers, but also sites for lookout stations, forest nurseries, storehouses for tools and other fire-fighting equipment, corrals and summer pastures, logging landings, sawmill and dam sites, and many other requirements. As development of the forests progresses and their use by the public becomes intensive the number of administrative sites needed will grow greater. It was early seen that if proper facilities were to be available for the transaction of business and the stationing of forest officers where they would be required, future needs must be anticipated. Instructions were therefore issued for the selection of advantageous sites wherever it might appear that they would be wanted later.

The Department of the Interior has withdrawn, at the request of the Secretary of Agriculture, 4,208 national forest administrative sites: of this number, however, 651 were subsequently released as not needed for public purposes. Many sites have also been reserved through the posting of notices by forest officers and approval of their reservation by the district forester, but without withdrawal by the Department of the Interior. A large number of these sites have upon them improvements in the form of ranger cabins, barns, corrals, fences, lookout towers, signal stations, nursery and planting stations, etc. Many of these sites cover less than 25 acres each. A large part of them are located where agriculture is impossible.

During the year 31 sites were withdrawn from unreserved public lands by Executive order. There were 167 recommended for release. The total number held either through such reservation or through withdrawals was, at the close of the year, 6,027 administrative sites of all classes.

The ranger stations now provided for by site reservations will furnish in the neighborhood of one station to every 60,000 acres. In the heavily timbered districts there should be during the dry season, if the forests are to be well protected, at least one patrolman to every 10,000 acres. Far from being excessive, the number of stations now reserved makes but indifferent provision for the needs of more than the next few years. Successful protection of the forests requires not only an adequate force but a well-placed force. Many forest fires are promptly extinguished each year which would do great damage if ranger stations were not fairly near at hand. The matter is of importance in the same way that properly distributed engine houses are of importance in the control of city fires.

Since ranger stations must be placed where forest officers can either actually live with their families throughout the greater part of the year or make headquarters during the summer months, with sufficient feed for their saddle and pack horses, it is necessary to select for this class of sites areas which furnish a fair amount of arable land or pasture. That this has been felt as a hardship is strong evidence of the nonagricultural character of the forest lands as a whole. The Government must obviously provide for its own needs; but it does not displace settlers already in possession or reject applications for the listing of land in order to take the land for public purposes. Instructions which have been in force since April 19, 1909, forbid the reservation as administrative sites of any tract application for which as a forest homestead is pending.

COST AND RECEIPTS.

The following tables show the gross cost of administration and protection, expenditures for permanent improvements, and receipts from the several sources, both in totals and per acre, during the year, as compared with those for the fiscal year 1911. The per-acre expenditures and receipts are computed on the basis of the gross area of all national forests under administration at the close of the year, since the cost of administration is not materially lowered by private holdings within the forests.

Expenditures for administration and protection and permanent improvements during the fiscal year 1912, compared with 1911.

Fiscal year.	Administration and protection.		Permanent improvements.	
	Total.	Per acre.	Total.	Per acre.
1912.....	\$1,718,668.96	\$0.02518	\$499,158.55	\$0.00266
1911.....	5,335,886.97	.02766	273,634.42	.00142

Comparison of receipts from the several sources for fiscal years 1912 and 1911.

Fiscal year.	Timber.		Grazing.		Special uses.		All sources.	
	Total.	Per acre.	Total.	Per acre.	Total.	Per acre.	Total.	Per acre.
1912.....	\$1,089,702.04	\$0.00581	\$968,842.26	\$0.00517	\$98,812.27	\$0.00053	\$2,157,356.57	\$0.01151
1911.....	1,014,769.84	.00526	935,490.38	.00491	76,645.93	.00040	2,026,906.15	.01065

Refunds of excess deposits (as, for example, deposits made by buyers of timber in advance of cutting) have not been deducted from the receipts given above. The refunds of timber receipts in 1912 amounted to \$39,731.02, and of all receipts to \$48,099.66. A deduction of the refunds would leave the total of receipts for 1912 \$2,109,256.91, as against \$1,968,993.42 for 1911. These figures show an increase in total receipts of \$140,263.49. The increase in receipts from timber, after deducting refunds, was \$83,377.61; from grazing, \$33,521.99; and from special uses, \$23,363.89.

FOREST MANAGEMENT.

TIMBER RESOURCES OF THE NATIONAL FORESTS.

The total stand of timber on the national forests, including Alaska, is now estimated at the equivalent of 597,478,000,000 feet, board measure. Of this amount slightly more than 23,000,000,000 is in protection forest on the upper parts of watersheds, where no cutting can be done. Approximately 348,000,000,000 feet is mature and over-mature. Accurate determination of the annual yield is not yet possible, but it may be put at about 6,150,000,000 feet. The annual requirements of the localities in the vicinity of the national forests may be roughly estimated at 305,000,000 feet under sales and

137,000,000 feet under free use. On the basis of the annual yield this would leave available for sales to supply the general market approximately 5,700,000,000 feet.

BROAD FEATURES OF MANAGEMENT.

The work of obtaining a detailed inventory of national forest timber was continued. Areas upon which sales are pending were given first consideration. The work was carried on to a smaller extent on other areas. Its purpose is to enable a more intelligent location of sales and to furnish a more exact basis for efficient management. Expenditures in timber reconnaissance are restricted because of the greater importance and the immediate urgency of protection from fire and the classification and segregation of agricultural lands. Intensive reconnaissance covered, however, during the year approximately 5,250,000 acres at an average cost of slightly more than 3 cents per acre. This makes a total area covered intensively of approximately 12,850,000 acres. In addition, approximately 8,890,000 acres were covered by extensive methods, bringing the total covered by extensive reconnaissance to about 32,000,000 acres.

The completion of the stock taking upon individual forests makes possible the preparation of forest plans, the object of which is to systematize and control the management of each forest upon a definite basis which shall represent the cumulative experience and information applicable to the specific task. Furthermore, detailed estimates of the standing timber and studies of logging conditions and costs are necessary before sales can be made. The increase in the volume of timber sales must be accompanied by greater expenditures for this essential preliminary work.

Because of the wide diversity not only in the resources of the forests, but also in the demands for their use, it has been necessary with the limited funds available to provide (1) for preliminary plans, covering forests where only approximate data are now needed, and consisting simply of a systematic statement of the resources of the forests, the conditions governing their use and development, and the administrative measures to be followed in their management; and (2) for working plans, prepared only where the demand for the forest resources as compared with the supply is relatively great. Working plans are more complete and final in character, and are based upon more thorough investigations and more accurate data. They include: A statement of the timber resources, and specific provisions for management; a similar statement of the range resources with an outline of management methods to be followed; provisions for the classification and segregation of agricultural lands and for the reservation of lands needed for administrative and public purposes; provision for the administration of miscellaneous forest uses, including water power, with as complete a statement of resources under each as is possible and desirable; the most intensive and detailed provision possible for protection of the forest from fire, based upon a statement of the value and distribution of destructible resources and the hazard or risk by regions within the forest and the methods of control actually necessary for efficient protection; provision against insect infestation or other damaging agencies which may threaten; a com-

prehensive outline of the improvements needed on the forest so far as they can be foreseen, with an indication of the approximate order in which they should be taken up; and finally, a complete summary of the administrative force needed to conduct all lines of work economically and efficiently, together with the estimated cost of these lines of work and their proper correlation. In short, they cover every phase of forest administration. Working plans outline the general scheme of management in a broad way for a long period, and in considerable detail for some such period as 10 to 15 years.

The collection of the detailed data for working plans is carried on under the immediate direction of the supervisors, with inspection and supervision from the district offices and Washington. Completed plans are finally reviewed by the assistant foresters in charge of each branch, and approved by the Forester.

Preliminary plans are being prepared as rapidly as practicable for all forests except those on which working plans are needed. Working plans are now in preparation for the following forests: The Kaniksu, where the demand for western white pine has become very great, and sales are desirable to permit the listing of agricultural lands; the Deerlodge, on which there is a very extensive demand for timber to supply the Butte mines; the Crook, where approximately the total production of the forest is and will be needed to supply the needs of settlers in and near the forest; the Coconino and Tusayan, where there has been for a number of years an extensive demand for yellow-pine timber for the general market; the Gila, where a strong demand has existed for fuel wood to supply the mines at Mogollon; the Plumas, from which it will be possible to dispose of a large part of the annual production to supply the general market; the Medicine Bow, with a large amount of material suitable for railroad ties, which in the future are practically certain to be in great demand for railroad maintenance and extension; and the Florida, where an active naval stores industry is ready to utilize the entire turpentine yield of the forest that can be made available.

The regulation of yield in the intensively managed forests of Europe is one of the most important phases of administration. The importance of regulation within the national forests will increase in exactly the proportion that their use becomes intensive. Another step toward intensive management was taken during the year by the determination within all of the districts of regulation units or divisions based upon topography, transportation facilities, and the logical markets, either local or general, which should be supplied from each area. The division boundaries are independent of existing forest boundaries. Usually the authorized annual cut for each division will not exceed the annual production by growth. Where, however, a large part of the total merchantable stand is mature and overmature, a cut in excess of the annual yield is justified both to prevent waste and to put the forest in a condition in which the production of wood will be far more rapid. Based upon the estimated annual growth and the amount of mature and overmature timber, the total cut authorized from all divisions for the fiscal year 1913 is 6,327,232,000 board feet, including 176,685,000 feet for free use.

The Forest Service has in the past cooperated with the Bureau of Entomology in order to protect the forests from insect ravages. Because of the necessity for correlating insect control with such work

as cruising, the marking of timber for cutting, and brush disposal the service has, with the consent of the Bureau of Entomology, taken over the routine field work. Cooperation is to be continued in the control of special outbreaks for which proper methods are not yet known and along investigative lines in order to develop and improve existing methods of control. A trained force of forest officers for this work will be developed as needed. It has already been necessary to assign one man each to districts 1, 5, and 6.

THE TIMBER SALE POLICY.

The national forests contain nearly 600,000,000,000 feet of merchantable timber. Nearly 350,000,000,000 feet is ripe for the ax and deteriorating in value, rapidly on areas swept by fire, gradually on areas where the forest is mature and the trees are slowly yielding to decay. Standing timber, unlike coal deposits, can not be held in storage indefinitely. To the extent to which the overripe timber on the national forests can not be cut and used while merchantable, public property is wasted. It has already been pointed out that the annual growth of wood on the national forests is equivalent to over 6,000,000,000 feet of lumber. This much can be cut every year for all time without depleting the supply. To utilize the rapidly deteriorating material and to aid in making the forests self-supporting the actual cut will be increased to approximately 3,000,000,000 feet annually as soon as possible. The conservativeness of this policy is evident when it is considered that there will be cut each year but 50 per cent of the annual growth on the forests, and less than 1 per cent of their total stand of mature timber. Notwithstanding the increased cut contemplated, this policy will reserve large amounts of timber for use during the period when the effects of the timber shortage are beginning to be felt.

To put the national forests to use their ripe timber must be sold under conditions practicable for the lumbering operator. Under the policy in effect until last year of refusing to dispose of more than approximately 100,000,000 feet in one sale or to allow a period for cutting of more than five years, the annual sales of timber have always been less than 1,000,000,000 feet. A large percentage of the mature national forest timber is comparatively inaccessible, and, although it occurs in large bodies, heavy investments are required for the development of the transportation facilities necessary for its removal. In two particular cases this investment was estimated at more than \$1,500,000. A change in policy to permit the sale of larger amounts of timber with longer periods for cutting was mentioned in last year's report. This change has been well received by purchasers and has increased the demand for timber. Instead of an arbitrary limit the amount which will be included in any sale is now determined by the actual physical conditions met in logging and the amount of capital which must be invested. Enough timber is included in each sale to justify reasonable men in making the investment necessary for its exploitation. The investment required is estimated by forest officers. More than sufficient timber to justify the outlay which the physical factors necessitate is not sold.

In these large sales a contract period sufficiently long to cut the timber under a continuous operation, considering the physical factors of the situation and the amount that the tributary markets will absorb, is allowed. When this period exceeds five years, provision is made for a readjustment of stumpage prices at the end of each three, four, or five year interval. Provision is also made for changes in the contract requirements which will insure utilization, methods of logging, and silvicultural practice fully up to the best standards developed in the region at the time of each periodic readjustment of prices. The original stumpage appraisal is based upon a close estimate of the cost of manufacture and the market price of the product. It permits a fair operating profit to the purchaser on his actual investment in the business, but no more. It is, as nearly as the experts of the service can determine, the full market value of the timber where it stands. As a further insurance of full value to the Government in larger sales, the period of advertisement of at least 30 days required by law is increased to from 2 to 6 months. The period of advertisement in all cases gives full opportunity to any interested persons to make field examinations of the timber. All possible further publicity which will tend to increase interest and competition is sought. The plan of price readjustment most commonly used in the negotiations of the last year was one based upon a comparison of the average mill-run lumber prices during a specified period immediately preceding the date of readjustment with the prices existing at the date of the original appraisal. The Forester, in his discretion, may increase the stumpage price by such an amount as he may deem equitable, up to 75 per cent of the increase in lumber values. The operator is justly entitled to a portion of the increase in the market value of his product, to offset increases in the cost of production and other inherent contingencies.

In sales of large amounts of timber with long cutting periods special precautions are necessary to prevent speculative purchases and the monopoly of timber holdings. The readjustment of stumpage prices largely precludes speculative profits. Other safeguards against speculative purchases are provided by requiring a fixed minimum cut during specified periods which vary from one to five years, but in the larger sales are usually from three to five years; by making sales only to bona fide operators who are financially able to complete them; and by refusing to allow the assignment of contracts. Monopoly is prevented by (1) advertisement and publicity; (2) requiring that railroads and other transportation facilities constructed shall be available under reasonable terms for the use of other purchasers of national forest products, either by becoming common carriers or otherwise; (3) the use of administrative discretion in the approval of bids. When any question of monopoly through the possible control of large quantities of timber by affiliated operators arises, a certified statement of the relation of the applicant or bidder to other purchasers of national forest timber may be required. A certified statement of the membership of firms or lists of stockholders in corporations may similarly be required. Lumber companies already holding large amounts of timber on private lands may be refused sales if there are any other purchasers, and companies having one sale may be refused others until the first has been cut. Further safeguards against monopoly are found in that practically without exception the construction of rail-

roads or other transportation facilities in connection with each sale will result in making additional timber available, and that even the largest sales, which may extend through a maximum period of 10 to 20 years, cover but a small fraction of 1 per cent of the merchantable timber on the forests.

Large sales are made only where they furnish the sole means of utilizing inaccessible timber. The experience of seven years has shown that much timber can be disposed of in no other way. The refusal to make such sales would result in great loss of timber, which is already deteriorating. Each sale made under such conditions not only prevents waste, but makes productive an area where now growth is offset by decay. The construction of transportation facilities in connection with every large sale develops and increases the value of other bodies of timber. In a recent case in California the increase in the value of timber not sold was estimated to be considerably more than the purchase price of the timber placed under contract. With the use of a railroad or other improvements granted to subsequent purchasers, the public will secure greater returns from adjacent bodies than it could ever have obtained had the first sale not been made. Finally, every sale of this character opens to general development a region previously locked up; it makes possible new mining operations, aids agricultural development by affording an outlet for crops, creates local business, and draws in population.

The annual yield, or amount of timber produced annually upon any area, must be the ultimate basis of the cut. It is absolutely necessary that provision be first made on each market unit for meeting local needs. Enough timber for such needs, if it is available, is reserved. The following examples illustrate the application of this policy:

Upon the Deerlodge National Forest, in Montana, the annual yield is estimated to be 40,000,000 board feet, all of which is needed to supply the mines at Butte. From this forest no sales to supply any outside markets will be considered. Upon the Holy Cross National Forest, in Colorado, the annual yield is estimated to be 6,000,000 feet, and since it is believed that local markets will require all or practically all of this amount, sales for the general market are not made. The limitation of cut on the Sioux Forest is 4,650,000 feet. Experience has shown that approximately 4,150,000 feet annually, practically all of the timber which can be cut, will be used locally.

On many forests, however, the excess of production over the amount needed for local consumption is very great. On the Cascade National Forest, in Oregon, the annual production is estimated to be 200,000,000 feet, while present local needs can be supplied by approximately 1,000,000 feet. Local consumption on the Sierra National Forest is less than 700,000 feet annually, while the cut allowed is 260,000,000 feet. From such forests a large cut for the general market can safely be permitted.

A cut in excess of the yield will be authorized in a few divisions or forests which have a large amount of mature and overmature timber and a strong demand, and on which restrictions to provide for a sustained local supply are not needed. Until transportation and market facilities are more evenly distributed, demand must enter largely into the determination of where sales shall be made.

So far as possible, data for timber sales are gathered in advance of application, with a view to interesting prospective purchasers and in order that sales may be made where cutting is most desirable. An office has been established in Chicago, from which information is furnished eastern lumbermen. This has resulted in numerous inquiries and several field examinations of timber which should be cut. Circulars have been prepared describing such bodies of timber and are mailed or presented to persons who might be interested.

THE TIMBER-SALE BUSINESS OF THE YEAR.

The timber-sale business of the year is shown by the following statement of the amounts and value of timber sold and timber cut under sales by States:

Timber sold and cut under sales on the national forests, fiscal year 1912.

State.	Timber sold.		Timber cut under sales.	
	Amount.	Value.	Amount.	Value.
	<i>Board feet.</i>		<i>Board feet.</i>	
Arizona.....	18,177,000	\$35,467.45	47,433,000	\$136,354.22
Arkansas.....	15,309,000	38,078.40	9,130,000	21,336.54
California.....	109,214,000	232,697.81	43,914,000	97,239.33
Colorado.....	77,745,000	149,271.60	43,484,000	85,662.38
Florida.....	70,000	78.00	35,000	33.59
Idaho.....	207,389,000	345,429.32	65,656,000	141,115.25
Kansas.....				
Michigan.....	4,000	14.29	4,000	14.29
Minnesota.....	658,000	2,970.70	617,000	2,873.87
Montana.....	110,637,000	228,723.33	55,911,000	141,691.14
Nebraska.....				
Nevada.....	2,976,000	8,928.34	2,030,000	5,241.17
New Mexico.....	26,973,000	75,050.49	17,612,000	40,187.05
North Dakota.....		1.20	2,000	2.40
Oklahoma.....	33,000	95.50	33,000	95.50
Oregon.....	150,985,000	349,283.50	29,337,000	59,965.30
South Dakota.....	12,375,000	32,363.33	9,600,000	23,931.02
Utah.....	13,415,000	31,297.37	11,487,000	27,638.54
Washington.....	10,939,000	21,216.61	37,532,000	74,797.06
Wyoming.....	3,593,000	5,902.56	12,937,000	33,736.12
Alaska.....	38,924,000	43,903.75	44,648,000	50,904.44
Total, 1912.....	799,416,000	1,600,773.55	431,492,000	942,819.21
Total, 1911.....	830,304,000	2,122,539.05	374,678,000	842,992.85

The total value of the timber cut under sales as given above differs from the receipts from timber as reported on page 38, both because the latter includes the receipts from timber and fire trespass and because timber is paid for in advance of cutting, with the result that the payments made during any year and the cut of that year under sales do not precisely correspond.

The amount of timber sold was 30,000,000 feet less than in 1911, but the cut increased nearly 60,000,000 feet, and the receipts from sales were \$100,000 greater.

In district 1, including Montana and northern Idaho, efforts were concentrated upon disposal of the timber killed by the fires of 1910. Detailed examinations show only approximately 3,225,000,000 feet killed, a material reduction from the early estimates. Of this, nearly 900,000,000 feet of merchantable timber is reasonably accessible under present conditions. Slightly more than 400,000,000 feet has been sold,

and applications are pending for about 180,000,000 feet more. Rapid deterioration makes further sales improbable.

The selling of much of the fire-killed timber was complicated by the intermixture of Government and unperfected private holdings. To operate, purchasers required solid blocks; on lands of unperfected title, however, the Government could neither sell nor allow the claimant to sell without some provision against loss should the lands never pass to the claimant. The main difficulty arose in connection with the unclassified or unsurveyed Northern Pacific lands. An opinion from the Attorney General, however, made it possible to allow the cutting of the timber from unperfected private holdings after the filing of a bond sufficient to protect the interests of the United States. Working under this opinion a cooperative agreement was drafted with the Northern Pacific Railroad whereby the company agreed to dispose of its timber and to bear its proportionate share of the expense of scaling, running of lines, and general supervision. The same general plan was followed in the case of timber on unperfected homesteads.

There is an active demand for the white pine and other timber on the Kaniksu National Forest in this district, and the sale of 450,000,000 feet to several local operators during the coming winter is under consideration. These sales are particularly desirable, since they will make possible the opening of from 12,000 to 15,000 acres of agricultural land, now heavily timbered, to settlement. Tentative applications for large tracts in northern Montana for the manufacture of paper pulp have also been received.

District 1 is the only district showing increased sales during the year. The cut has showed little change. In district 2, including South Dakota, Colorado, and much of Wyoming, both sales and cut fell off. This was due largely to the retrenchment policy of the trans-continental railroads, which have in the past bought for ties much of the timber sold, especially in Wyoming. Other sales for local consumption in district 2, on the whole, fluctuated little from preceding years. An increase in the total sales business of this district over that of preceding years may be expected as soon as new contracts for ties are made by the railroad companies. It is anticipated that this will take place in the near future.

In district 3, including Arkansas, Arizona, New Mexico, and Florida, receipts increased. In Arkansas increasing sales and demand emphasize the importance of securing better utilization in the manufacture of cooperage stock, which takes a high grade of material and wastes much timber of value for the manufacture of lumber and other products. Investigations are now being made to determine the percentage of loss in stave manufacture as compared with ordinary logging.

Tentative applications have been received in Arizona for sales to supply the mining markets in the southern part of the State, which heretofore have secured their material from the Pacific coast, an obvious economic loss when timber within a few miles is available. Pending sales for this market and for the general yellow-pine lumber trade involve a total of more than 500,000,000 board feet.

In district 4, which includes Utah, southern Idaho, and western Wyoming, practically all the timber sales of the year were small,

to supply local needs. The cut was substantially the same as in 1911. Large sales and even many small sales were prevented by the competition of Pacific coast and eastern Oregon mills, which undersell local operators. One result of the general depression in the Pacific coast lumber industry which has characterized the past three years, and which apparently reached its lowest level in 1912, has been the supply of the markets of district 4 with imported lumber at practically cost prices. The large local market in Utah and southern Idaho, however, has led to tentative applications for tracts in the Boise and Payette forests, and the sale of at least 300,000,000 feet in this region within the next year is anticipated.

In district 5, covering California, the receipts from timber sales increased. Actual sales fell off slightly, but a marked increase took place in demand, particularly for remote bodies of sugar and yellow-pine timber under long-term contracts. This is an accompaniment of the general activity in the lumber industry of California due to the anticipated completion of the Panama Canal and building preparatory to the Panama Exposition. Under the large-sales policy, contracts were entered into disposing of 90,000,000 feet on the Tahoe and 183,000,000 feet on the Shasta. Negotiations are in progress for a sale of 800,000,000 feet on the Sierra. In addition, sales are under consideration on the Klamath, Sierra, California, Lassen, and Tahoe forests aggregating over 2,000,000,000 feet.

Sales in district 6 (Washington, Oregon, and Alaska) were mainly in the yellow-pine belt in southern and eastern Oregon. Receipts showed a substantial increase. Cutting began on two new sales on the Whitman, one of 57,000,000, the other of 74,000,000 feet, and negotiations in a third sale of 60,000,000 feet were practically completed. Other areas aggregating 100,000,000 feet are in demand on this forest and will probably be placed under contract during the next six months. A very active demand for western hemlock and Sitka spruce for wharf and track piling developed on the Tongass Forest in Alaska. The depression in the Douglas fir belt on the coast still continues. During the latter half of the year, however, lumber prices advanced, and this was reflected in renewed sale applications, in some cases for large amounts. The policy regarding large sales is particularly adapted to the conditions in the forests of the Northwest and played its part in the renewed interest in national forest timber.

In all but two of the national forest districts, therefore, conditions improved during the year. The total cut rose from 374,678,000 feet to 431,492,000 feet, and receipts from \$842,992.89 to \$942,819.21. Sales fell slightly below those of 1911. The new policy covering large sales was in effect long enough to complete only two sales. The time required for the detailed examination of the large areas applied for, for the careful consideration of all terms of the contracts, and for the long advertisements necessary to promote competition have made it impossible to consummate most of the larger sales, on which an immense amount of work has been done during the year. Consummation in 1913 of even a few of the large sales now under consideration and already enumerated will bring a greatly increased total for that year. While it is not to be assumed that all these applications will result in sales, they are, in the aggregate, a strong indication of a materially improved market. There are more of them

than ever before at any one time, they are for much larger amounts, and for a number of them negotiations appear to be nearing completion. The increased activity in the lumber market also presages a much larger volume of sales business than ever before.

The sales in 1912 of nearly 800,000,000 feet, or almost twice the actual cut, following the sale in 1911 of 830,000,000 feet, gives every indication of a substantial increase in the 1913 receipts. This may be more confidently predicted since the receipts for the first three months of the year 1913 exceed those for the same period of the year 1912 by approximately \$80,000. The average price received for timber sold during the year was \$2, as against \$2.56 for the year 1911. The decrease was due chiefly if not wholly to the large amount of fire-killed timber sold at low rates.

The following classification according to the size of sales shows that out of a total of 5,772 sales, 5,727 were for amounts less than \$5,000, and that 5,179 were for amounts under \$100. Through small sales the Forest Service supplies the needs of the people living in and near the forests and furnishes business opportunities to the small operator. It is the aim to give all possible encouragement to such sales, which in the long run should form the mainstay of the national forest timber business. The new policy with regard to large sales by no means substitutes such sales for those made to supply the small mill, but opens up new territory which the small operator will be able to enter later on.

Number of timber sales, fiscal year 1912, classified according to amount of sale.

State.	Under \$100.	\$100 to \$500.	\$500 to \$1,000.	\$1,000 to \$5,000.	Over \$5,000.	Total number of sales.
Arizona.....	507	27	3	1	1	539
Arkansas.....	28	10	2	7	2	49
California.....	575	37	9	12	2	635
Colorado.....	674	30	14	19	6	743
Florida.....	6					6
Idaho.....	463	60	8	7	8	546
Kansas.....						
Michigan.....	3					3
Minnesota.....	2	1	1	1		5
Montana.....	1,131	95	20	25	7	1,278
Nebraska.....						
Nevada.....	261	8		1		270
New Mexico.....	287	16	3	3	4	313
North Dakota.....	1					1
Oklahoma.....	33					33
Oregon.....	198	6	3	5	9	221
South Dakota.....	149	1		1	2	153
Utah.....	364	20	4	6	1	395
Washington.....	67	7	4		2	80
Wyoming.....	133	11	3			147
Alaska.....	297	49	4	4	1	355
Total, 1912.....	5,179	378	78	92	45	5,772
Total, 1911.....	5,144	327	70	73	39	5,653

SALES OF TURPENTINE.

The application of forest management on the Florida National Forest includes provision for turpentine. The old method of boxing was very destructive of timber, and some years ago the Forest Service introduced conservative methods which reduce such loss to a minimum. When the Florida National Forest was placed under

administration, naval stores operators hesitated to adopt the conservative methods required by the Government, and few turpentine leases were made during the first year. Contrary to the expectations of the operators, however, conservative regulation has increased the yields. Although regulation during the past year was more strict than ever before, demand for turpentine contracts greatly increased. In all, turpentine leases on the Florida National Forest in 1912 yielded \$16,658.47, as compared with \$8,268.68 in 1911. Prices during the first year averaged only \$50 per thousand cups; last year they averaged \$100 per thousand cups, with a maximum of \$118. It is almost certain that, if it were consistent with good management, all the timber within the forest could be placed under turpentine contracts in a short time without difficulty. The conservative methods employed greatly prolong the period of turpentine production. Estimates place this at from 15 to 20 years. The forest is under a plan of management which groups turpentine permits on areas where timber sales may easily be made after the turpentering is over. Management by groups of permits has been found to result in better competition and better fire protection. While utilization of the timber for naval stores puts off the time when it can be sold and cut, turpentering must be considered a very important phase in the utilization of the trees.

The great demand for naval stores products, together with the rapidly diminishing supply of timber in the Southeast, has made it necessary for operators to seek new fields. Successful experiments conducted by the Forest Service in turpentering western yellow pine in the Southwest and in California have aroused interest among operators. Experimental sales are planned in Arizona and California.

TIMBER TRESPASS.

The receipts for timber cut in trespass were \$40,290.68, as against \$43,236.37 in 1911. At the beginning of the year there were 189 timber trespass cases pending, and 172 new trespasses were reported during the year. Fifteen cases were reported to the Department of Justice for prosecution, 114 settled by the trespasser upon request, and 67 dismissed for want of sufficient evidence or for other reasons; thus 165 were pending at the close of the year.

STUDY OF BUSINESS ASPECTS OF TIMBER SALES.

With the increase in the size of sales considered and the necessity for greater care in original stumpage appraisals, much attention has been given to two lines of study which should prove of the utmost practical value. The first consisted in the standardization of methods of determining reasonable profit for operators and appraising stumpage after detailed logging and manufacturing costs have been obtained. The second provided for the beginning of an intensive study into logging and manufacturing costs, with the idea of standardizing such costs by regions for different classes of operations. In addition, fundamental principles upon which to base the selection and application of the various methods of logging will be sought. A successful completion of this study should be of great benefit to lumbermen, as well as to forest engineers. It should also make possible the securing of data in sales so nearly accurate that appraisals

by forest officers will be accepted with confidence by lumbermen and timber purchasers.

FREE USE.

The following table summarizes the free use of timber on the national forests for the year:

Free use of timber on national forests, fiscal year 1912.

State.	Number of permits.	Quantity.	Value.	State.	Number of permits.	Quantity.	Value.
		<i>Board ft.</i>				<i>Board ft.</i>	
Arizona.....	1,796	5,025,000	\$10,752.12	New Mexico....	4,452	12,836,000	\$18,844.16
Arkansas.....	144	521,000	1,088.35	North Dakota...	146	41,000	47.50
California.....	2,756	8,490,000	14,797.95	Oklahoma.....	454	199,000	427.70
Colorado.....	3,877	11,621,000	18,619.35	Oregon.....	2,898	13,176,000	19,839.90
Florida.....	4	4,000	17.10	South Dakota...	1,292	5,689,000	5,512.20
Idaho.....	5,775	19,841,000	29,586.34	Utah.....	5,938	15,099,000	19,948.28
Kansas.....				Washington.....	487	2,073,000	4,158.73
Michigan.....	6	32,000	30.00	Wyoming.....	1,706	6,722,000	7,876.21
Minnesota.....	20	120,000	362.00	Alaska.....	(¹)	395,000	397.75
Montana.....	6,118	18,239,000	38,025.04				
Nebraska.....				Total, 1912.	38,749	123,233,000	196,335.41
Nevada.....	880	3,060,000	6,004.79	Total, 1911.	40,660	123,488,000	196,930.24

¹ Under Reg. 3-27 timber is taken in Alaska without permit. The figures for quantity and value in Alaska are estimates only.

Of the total amount, 33,379,000 board feet was live timber and 89,854,000 dead, valued, respectively, at \$88,496.96 and \$107,838.45. There was practically no change in the amount and value of the material taken during the year, but the number of permits decreased slightly. A particular effort has been made to decrease the cost of administration without lessening the protection given to the forest, through the development of more simple and economical methods. Some of these are: The concentration of use on specific areas convenient to users; issuing permits for an entire or a considerable part of the fiscal year; mailing at the beginning of the fiscal year, to residents entitled to free use, year-long permits for timber on specified free-use areas; and encouraging applications from those entitled to the privilege so far as practicable during the season in which other work is slack.

LOSSES BY FOREST FIRES.

THE FIRES OF 1911 ON NATIONAL FORESTS.—The statistics of fire losses are compiled by calendar years, since the season of greatest hazard, during the warm or dry months, is included within two fiscal years. The climatic conditions during 1911 were generally favorable to fire protection, and the service was better prepared than ever before to discover, report, and extinguish fires.

The total area of national forest lands burned over was 469,638 acres, of which 348,783 acres were timberland and 120,855 acres open. The loss in timber destroyed or damaged was 117,174,000 board feet, with an estimated value of \$172,385. There was also a loss in reproduction estimated at \$176,406, and of forage valued at \$5,955, making a total national forest loss of \$354,746.

On private lands within the forests 310,342 acres were burned over, of which 267,107 acres was timber and 43,235 acres open. The loss

in timber amounted to 27,049,000 board feet, valued at \$37,376. The total cost of fighting the fires upon national forests and fires which threatened national forest land was \$202,046.36. This does not include time spent by regular forest officers.

The timbered area burned over per 1,000 acres was 1.78 acres in 1911, as against 1.86 in 1909, and 19.90 acres in the disastrous 1910 fire season.

The number of fires during the season of 1911 and their causes are set forth in the following table:

	Number.	Per cent.
Number of fires:		
Class A (no damage).....	1,571	46.63
Class B (under 5 acres burned).....	583	17.31
Class C (5 acres or over).....	1,215	36.06
Total number of fires.....	3,369	100.00
Causes of fires:		
Lightning.....	948	28.14
Campers.....	574	17.04
Railroad locomotives.....	442	13.12
Incendiary.....	225	6.68
Brush burning.....	199	5.90
Sawmills and donkey engines.....	33	.99
Unknown.....	743	22.05
Miscellaneous.....	205	6.08
Total.....	3,369	100.00

A special study of lightning in relation to forest fires was completed and published. This summarized 76,301 cases of trees struck by lightning on the national forests, together with many thousands of cases in the Eastern States. Lightning will always remain an unpreventable cause of forest fires, and must therefore always be considered in the protective scheme on the national forests. The records for the years 1907 to 1911, inclusive, show that 17.5 per cent of all forest fires on national forests were caused by lightning.

The table shows that 6.68 per cent of the fires were incendiary. This is a slight increase over the number for the previous year. The means for determining whether a fire is incendiary are better than formerly, and some fires were doubtless classed as incendiary in 1911 that would have been counted of unknown cause in 1910.

There are various ways of determining whether a fire is incendiary. Usually a number of fires are started at the same time in one locality. If there is no electric storm or other reason for such a series of fires, the assumption is safe that it is due to incendiarism. In a number of instances the observer at the lookout station has seen such a series starting along a road or trail at just about the time interval required to walk between the points. In several instances tracks between the starting points of a series of fires have indicated an incendiary origin. Once a half-burned candle under a stump at the point where a fire started showed the cause. In another case an ingenious contrivance with a burning glass, a veritable infernal machine, was found. It is very difficult to catch the incendiary in the act on account of the small force at the disposal of the service. Several men have, however, been apprehended and their cases are now before the courts.

It is probable that incendiarism is on the decrease except in a few localities. The educational work done by the service in showing the damage by fires, the friendly feeling toward the organization and local personnel, and the vigilance of the fire patrol have worked together to reduce the number of fires from this source. During 1912 a large number of the incendiary fires occurred in northern California. These were primarily due not to ill feeling, but to the theory of light burning which is being preached by certain influential men of that State.

This theory is that, to protect the forest, fires should run over the ground every year, thus keeping down brush and getting rid of inflammable material. The object is to keep the woods open and thus prevent large fires. It was the custom of the Indians and early settlers to do this. The result has been a fearful devastation. This is particularly true in California, which actually has 30 to 50 billion feet less timber standing to-day than would have been the case had it not been for this practice. A continuance of it in the manner proposed will absolutely prevent a regrowth of forest on the old burns and would finally wipe out the forest altogether by putting a stop to reproduction.

One large timberman is carrying out the theory systematically and with great care on his own lands. He is spending about 50 cents an acre on the work and thereby is able to keep the damage down to a minimum, although a certain loss to small trees ensues. But the ordinary man simply sets the woods on fire when fire will run, regardless of this loss. The doctrine of light burning as popularly understood in California is nothing less than the advocacy of forest destruction, and those who preach the doctrine have a large share of responsibility for fires which their influence has caused.

CONDITIONS IN THE CALENDAR YEAR 1912.—At the time of writing this report the fire season is not closed and the data are incomplete. Preliminary reports on about 1,500 fires show that the season has been favorable to fire protection, excepting on the Colorado Plateau, where an unusual number of fires were started by lightning. In fact, it would appear from these incomplete figures that the season of 1912 will show a greater percentage of fires caused by lightning than any previous year in the history of the Forest Service. In some localities more than half the fires were thus caused.

PROGRESS IN PROTECTION.—In spite of the fact that so many of the fires occurred in regions of inaccessibility, the efficiency of the Forest Service fire-protective machinery shows as rapid progress toward perfection as can be obtained with the comparatively small force of patrolmen and lookouts who can be employed with the funds available.

In the classification on page 42 it has been the custom to assume 5 acres as the area which may be burned before a fire does any serious damage. Probably 10 acres would be a fairer basis of classification, since a fire of this size is either a ground or surface fire and has not become a general conflagration consuming the crowns of the trees or merchantable timber. The computation for 1911 is, however, based upon the 5-acre limit for class B fires and shows that 63.94 per cent of all the fires on national forests were extinguished by forest officers before this limit had been passed.

As shown under the section of this report dealing with permanent improvements, the mileage of trails and telephone lines was largely increased during the fiscal year 1912, and a considerable number of lookout stations were established and equipped. These improvements directly increase the efficiency of fire protection and fire suppression.

Special attention was given to the equipment of lookout stations, since it is obviously of the utmost importance that the location of a fire be reported and the fire reached at the earliest possible moment. These stations are equipped with specially prepared protractors and with alidades, and as rapidly as possible are being supplied with suitable maps. The protractors and maps are oriented, and as soon as smoke is discovered its direction is determined with an alidade, and its exact location is found by the intersection of sights from two or more stations. If the condition of the atmosphere is favorable the sight from one station is usually sufficient, since the man on duty is familiar enough with the country within range to describe the exact location of the fire.

Feld glasses and high-power prism binoculars are used at many of the stations. Experiments are being made to determine if the installation of special equipment will increase the efficiency of some of the higher and more important stations, and it is probable that in many locations special instruments, especially telescopes, will result in a saving of time in giving the alarm.

The locating of fires by triangulation methods has proved very successful. Obviously, however, this plan can not be used except in those forests having more than one lookout point connected by telephone. As rapidly as possible the lookout points have been put in telephone communication and this work is being vigorously extended. In the Arkansas and Ozark National Forests, for instance, where, largely because of topographic conditions, the need of a lookout patrol system received early recognition, approximately 75 per cent of the area of forest land is covered by a system of lookout towers connected by telephone. It was found necessary to construct towers on the lookout points in order to obtain a clear vision, and 30-foot wooden towers or 60-foot steel towers built on the style of a windmill have proved very effective.

At some of the lookout stations heliographs have been found useful for sending alarms of forest fires. The number in use is increasing, since experiments show them to be part of the necessary equipment of some stations where telephone connection is not yet established. For instance, the Okanogan National Forest, in Washington, has been equipped with heliograph outfits and reports from their use on this forest seem to show that they will be of great benefit.

The practical results of the lookout stations have been remarkable. In many cases fires have been definitely located at distances varying from 10 to 50 miles and word has been telephoned to the nearest rangers, who have promptly extinguished them. Lookout stations are of great value in the case of lightning fires. Sometimes as many as 12 fires are started by a single electric storm. The observer at the lookout station locates all of them and is able to direct the rangers just where each fire is, so that he can assemble the necessary force and equipment to put them out. Many instances have occurred where the machinery has worked like a city fire department and many thousands of dollars have been saved by the system.

On many of the national forests detailed fire plans were prepared, based on a careful and systematic study of local conditions. The complete fire plan consists of a description of the property exposure and fire hazard and of every means which has been or may be taken to meet any emergency which may arise. The fire plan is prepared by the forest supervisor and is modified and strengthened in the light of the experience of each fire season. Fire plans include a detailed outlining of the system which will, at minimum expense, afford the maximum protection which the conditions demand; an inventory of all fire-fighting equipment; accurate maps showing types of forest cover, danger areas, means of communication and transportation, and location of lookout stations, fire breaks, camping grounds, settlements, and other sources of supply for labor, equipment, food, and forage; determination of the fire liability of each type of forest based on the results of previous fires; means of transportation and communication between all portions of the forest and settlements where help can be obtained; detailed description of the lookout system necessary to cover the forest; what cooperation can be expected during the dry season or at the time of fires, and detailed instructions for each forest officer.

The fire plans have already shown exactly where permanent improvements are most needed, and have aided in the wise allotment of funds for improvement work. They have also supplied every supervisor and district ranger with a definite outline for the construction of trails, cabins, fences, and other projects, so that during rainy weather or at other times of least danger patrolmen can be immediately transferred to improvement work without any lost motion. Other features of the fire plans provide for an accurate system of check patrol by which the district ranger will at all times be aware of the movements of the patrolmen in his district, standardization of fire tools stored at different points, and arrangements to facilitate the purchase and transportation of food supplies.

The disastrous fires of 1910 showed the necessity of a much larger number of pack animals for use in transporting supplies and tools to fire-fighting crews, and a considerable number of such animals were purchased during the year. These are held at convenient points during the dry season, so that they can be utilized quickly. The cost of maintenance of these animals is comparatively small, since for a large part of the year they are kept on Government pasture. They are useful during the wet season in the construction of permanent improvements.

Great progress was made in the fire-protection cooperative agreements with States, railroads traversing national forests, owners of large bodies of timber in and adjacent to forests, and associations of lumbermen. Several railroads are using oil-burning locomotives in heavily timbered districts, and many are clearing their rights of way of inflammable débris. These cooperative agreements mean, in many instances, the material supplementing of the fire-protective force on the national forests during the summer months. In the Northwest there is almost no agency, private or public, which is not lending its assistance to the work of fire prevention and fire fighting. With all agencies in the field working toward a common end the danger of destructive fires must gradually grow less.

The problem of awakening the public mind to the great loss suffered annually from forest fires received much attention during the year. Letters were sent to representative citizens in the vicinity of each national forest, including the proprietors of hotels and resorts, calling their attention to the annual fire loss and asking for their cooperation in fire protection and suppression. In each letter the location of the nearest ranger district was given, together with the name, address, and telephone number of the ranger in charge. Many of the recipients of these letters replied, offering valuable suggestions for the better handling of the fire problem in their vicinity. In a number of instances local telephone companies inserted in their directories suggestions regarding camp fires and instructions as to reporting forest fires when discovered. Some of the railroads traversing national forest lands inserted in their summer time tables, at the request of forest officers, warning notices against carelessness with fires. Through these and many other means public sentiment in national forest States has become alive to the importance of fire protection.

There is a marked improvement in the status of fire-trespass cases. At the beginning of the year 78 cases were pending. During the year there were 93 new cases, making a total of 171 cases for consideration. Of these, 50 were dismissed, 62 were prosecuted, and 17 were settled, leaving only 42 cases pending at the close of the year. The receipts from fire-trespass cases settled during the year amounted to a total of \$21,810.70. Incendiarism and carelessness with fires can be largely decreased by promptly initiating legal action against the offenders, and many prosecutions were instigated and convictions secured.

As long as the protective force is inadequate there will always be a large element of uncertainty regarding the possible damage from forest fires. More than four-fifths of all forest fires are caused by man, and are therefore preventable. When a fire has once started, however, the chance of its becoming destructive depends largely on the inflammability of the forest, the time which has elapsed since rainfall, and the wind. These uncertainties and the added hazard which will always obtain from lightning make a much larger patrol force and more active cooperation from the people imperative. Fires must be discovered and extinguished before they obtain a start. A single fire which obtains a good start on an inflammable area and is fanned by a high wind may be impossible to control before it has done immense damage. A large preventive force is the thing needed to insure the national forests and surrounding regions against loss. Although fire organization is being developed to a high degree of efficiency, it is still far below what is needed to guarantee the safety of the Nation's timber. The number of rangers on the statutory roll is sufficient, but there are needed additional men for short periods during the dry season.

As a result of the fire disaster of 1910, Congress appropriated \$1,000,000 as an emergency fund to meet a possible similar situation the next year. The seasons of 1911 and 1912 were so favorable from the standpoint of rainfall that very little of this appropriation was used. Nevertheless, there may be almost any year a repetition of the 1910 drought, when it would be necessary to spend a very large amount of money to meet the emergency. Such an emergency fund

would be a great safeguard in the protection of the forests. Without it the Secretary of Agriculture would either have to create a deficiency or fail to protect the forests.

REFORESTATION.

POLICY AND DEVELOPMENT.—As outlined in the report for last year, reforestation work includes continued experimentation and investigation to find the cheapest and best methods and the seeding and planting of approximately 30,000 acres annually.

Some results of the experimental work are given under the heading "Forest investigations." Reforestation of an intensive character was confined to the experiment stations and to districts 3 and 5, where, on account of unfavorable climatic conditions, failures with reforestation on a large scale have been so persistent that such work should clearly be postponed until methods which promise success can be developed.

The tentative distribution among the districts of the area to be reforested annually is: District 1, 9,000 acres; district 2, 6,000; district 3, 500 (experimental only); district 4, 6,000; district 5, 500 (experimental only); district 6, 9,000.

The reforestation will be by two methods—direct seeding and planting. The area to be planted will depend upon the nursery stock produced. The annual capacity of the existing nurseries will be increased only where it can be done without increasing the cost of maintenance, or where some specific local condition or very definite advantage from such an increase requires such action. In general, the total cost for nursery work for the next few years will remain close to its present figure. With the nurseries maintained at approximately their present capacity, resources will be available for planting nursery stock as it reaches the right size and for seeding to bring the total covered by both methods as nearly as possible to the 30,000 acres planned for.

During the past year, to insure the selection of the most favorable areas, a definite policy was put into effect of making a detailed planting reconnoissance previous to actual reforestation. Where accurate maps are not in existence, the topography is mapped in detail.

To a greater extent than in the past, work was concentrated on a few selected forests and upon one or two definite sites on each forest. This was done both in planting and in direct seeding, but particularly in the latter. The desirability of concentration has been clearly established. It makes possible the preparation of more detailed plans previous to the commencement of the work, the securing of a large supply of temporary labor through advertisement, the reduction of overhead charges, closer and more efficient supervision, and the covering of a larger acreage with the same amount of money. It also facilitates the employment of a small force of well-trained men.

More careful organization of seed collecting and extracting operations has secured more economical methods in this line of work. Seed-collecting operations by the service were confined largely to yellow pine, Douglas fir, lodgepole pine, western white pine, and Engelmann spruce. The large mechanical seed-extracting plants mentioned in last year's report were completed—one for yellow pine

on the Harney, two for lodgepole pine on the Medicine Bow and Arapaho, and two for Douglas fir on the Oregon and Snoqualmie National Forests. The plant on the Harney has been tested with a trial run, and will be ready for handling cones collected in the fall of 1912. The lodgepole pine plant on the Medicine Bow was run for several weeks, during which over 3,000 bushels of cones were treated. The Wyeth kiln on the Oregon was in operation slightly more than 100 days, during which 11,834 pounds of seed were extracted from 11,547 sacks of cones. The average cost per pound of extraction of the 10,831 pounds of Douglas fir seed collected was 37 cents, and the cost during the last 40 days of operation after the perfection of the plant was 20½ cents.

The first application of the policy outlined in last year's report of concentration in seed collection in favorable seasons with a proportionate reduction in acreage seeded was made in district 6, to take advantage of a good seed crop of Douglas fir. This policy will result in the organization of the work within each district upon a basis of two or more years' work rather than an annual basis, and should make possible the reduction of costs in the long run by the concentration each year upon the particular part of the whole operation which can be done to best advantage. The areas to be reforested in different districts must therefore be considered as averages by periods of two or more years and not as areas which are to be reforested every year.

In connection with direct seeding, special investigations to solve the rodent problem are being carried on. Where on any particular site it is found impossible to control the rodents, direct seeding is not done. A careful record of the results of past experience has been put into effect and is constantly kept up to date, so that by analysis of these reports it is possible to plan more efficiently future reforestation work.

THE WORK OF THE YEAR.—In the table below is shown the amount of seed of coniferous and hardwood species collected in the six districts, the amounts of seed purchased by the service, and average costs per pound:

Source.	Conifers.		Hardwoods.	
	Clean seed.	Average cost per pound.	Clean seed.	Average cost per pound.
Collected by the Forest Service:	<i>Pounds.</i>		<i>Pounds.</i>	
District 1.....	9,215	\$2.35		
District 2.....	11,596	1.48	300	\$0.10
District 3.....	653	.70	8,100	.20
District 4.....	8,818	1.57		
District 5.....	2,041	.65		
District 6.....	15,632	1.66		
Total.....	47,955	1.68	8,400	.19
Native species purchased.....	5,164	.99	12,415	.362
Exotic species purchased.....	1,105	.17		
Grand total.....	54,224		20,815	

Of the 1,105 pounds of foreign coniferous seed purchased 800 pounds were maritime pine, which cost slightly over 8 cents per pound. The other 305 pounds cost, on an average, 41 cents per pound.

The total amount of seed secured during the fiscal year was 75,039 pounds, at a total cost of \$88,326.24.

The total area reforested was 20,543 acres, of which 14,369 acres were sown and 6,174 acres planted, at a cost for seed, nursery stock, equipment, and labor of approximately \$130,000. The average cost of reforestation, both by direct seeding and planting, was \$6.19 per acre. The acreage reforested was, by species, as follows:

Total area reforested, by species.

Species.	Area reforested.	Per cent.	Species.	Area reforested.	Per cent.
	<i>Acres.</i>			<i>Acres.</i>	
Western yellow pine.....	12,378.6	60.3	Incense cedar.....	43.0	0.2
Douglas fir.....	3,896.2	19.0	Other conifers.....	2,106.1	10.2
Lodgepole pine.....	1,182.3	5.7	Hardwoods.....	330.0	1.6
Engelmann spruce.....	425.6	2.1			
Sugar pine.....	104.4	.5	Total.....	20,543.1	100.0
Western white pine.....	76.9	.4			

The areas sown and planted were distributed as follows among the different States:

Sowing and planting, fiscal year 1912.

State.	Area sown.	Area planted.	Total area reforested.	State.	Area sown.	Area planted.	Total area reforested.
	<i>Acres.</i>	<i>Acres.</i>	<i>Acres.</i>		<i>Acres.</i>	<i>Acres.</i>	<i>Acres.</i>
Arizona.....	469.25	13.35	482.60	Nevada.....	512.00	23.06	535.06
Arkansas.....	71.00	31.55	102.55	New Mexico.....	180.66	204.50	385.16
California.....	632.69	188.60	821.29	North Dakota.....		30.00	30.00
Colorado.....	3,694.95	293.15	3,988.10	Oklahoma.....			
Florida.....	73.00	12.00	85.00	Oregon.....	30.57	1,101.22	1,131.79
Idaho.....	2,025.40	597.76	2,623.16	South Dakota.....	1,971.25		1,971.25
Kansas.....		60.25	60.25	Utah.....	690.88	1,008.81	1,699.69
Michigan.....	36.11	20.53	56.67	Washington.....	5.00	30.00	35.00
Minnesota.....	30.00	.67	30.67	Wyoming.....	191.35	.17	191.52
Montana.....	3,754.92	2,408.29	6,158.21				
Nebraska.....		155.12	155.12	Total.....	14,369.03	6,174.06	20,543.09

During the year 14,369 acres were sown direct. Of these 14,266.5 acres were sown to conifers at an average cost of \$4.06 per acre and 102.5 acres to hardwoods at an average cost of \$8.68, or of \$4.10 for both conifers and hardwoods. The cost of sowing hardwoods was on an average more than twice the cost of sowing conifers. This was due chiefly to the fact that the sowing of hardwoods was on a small scale.

The planting work included 5,946.5 acres planted to conifers, at an average cost of \$10.75 per acre, and 227.5 acres to hardwoods, at an average cost of \$19.54 per acre. Of the 5,573,147 plants used 55 per cent were transplants and 45 per cent seedlings. An average of 900 trees to the acre was planted. Most of the stock was older than two years. Experience has proved that it does not pay to use the younger age classes of nursery stock.

The following table shows the number and percentage of trees of each species planted:

Species planted, seedlings and transplants.

Species.	Number planted.	Per cent.	Species.	Number planted.	Per cent.
Douglas fir.....	2,570,160	46.1	Lodgepole pine.....	13,290	0.2
Western yellow pine.....	2,236,441	40.7	Other conifers.....	237,972	4.3
Engelmann spruce.....	235,500	4.2	Hardwoods.....	179,019	3.2
Incense cedar.....	42,000	.8			
Western white pine.....	15,415	.3	Total.....	5,573,147	100.0
Sugar pine.....	13,350	.2			

A total of 5,946.55 acres were planted during the year with conifers at an average cost per acre of \$10.73 and a total of 227.51 acres with hardwoods at an average cost per acre of \$19.54. The minimum cost per acre was \$4.19, on the Crater National Forest. The average cost of hardwood planting was higher than the cost of coniferous planting, because hardwood planting was done everywhere on a small scale. The handling of the hardwood stock is much more expensive on account of its bulk.

NURSERIES.—The annual capacity of the nurseries remained substantially the same as last year. That of the Halsey Nursery, in Nebraska, was increased to raise material for distribution among settlers of the Kinkaid district, as provided for under the agricultural appropriation act of March 4, 1911. The present supply of stock at each nursery is shown below:

Nursery.	Forest.	Seedlings.	Transplants.
Boulder.....	Helena.....	6,647,370	704,980
Savenac.....	Lolo.....	3,902,800	3,086,300
Trapper Creek.....	Bitterroot.....	250,000	332,780
Dakota.....	Dakota.....	101,500	292,000
Monument.....	Pike.....	1,239,000	833,000
Halsey.....	Nebraska.....	4,787,648	936,222
Garden City.....	Kansas.....	849,050	54,000
Animas.....	San Juan.....	53,250	21,296
Fort Bayard.....	Gila.....	309,000	83,700
Gallinas.....	Pecos.....	123,000	101,000
Frye Canyon.....	Crook.....	200,000	-----
Rocky Bayou.....	Florida.....	8,000	1,500
Uinta.....	Uinta.....	5,548,600	547,000
Wasatch.....	Wasatch.....	3,357,000	609,900
Pocatello.....	Pocatello.....	4,289,150	53,750
Cottonwood.....	Boise.....	62,000	-----
Long Gulch.....	do.....	280,410	490
Pine.....	do.....	23,300	4,600
Flowers.....	Sawtooth.....	115,500	3,300
Poorman.....	Fayette.....	2,500	-----
Pilgrim Creek.....	Shasta.....	485,000	392,576
Converse Flats.....	Angeles.....	61,100	38,200
Los Prietos.....	Santa Barbara.....	-----	-----
Wind River.....	Columbia.....	2,000,000	683,200
Silverton.....	Snoqualmie.....	620,000	225,000
Page Creek.....	Siskiyou.....	72,428	41,973
Others.....	-----	905,767	18,125
Total.....	-----	36,293,373	9,064,892

The average cost of seedlings was \$2.50 per thousand, and of trans- raised for experimental purposes, which is high. At some of the large plants \$6. This cost is increased by the inclusion of the cost of stock

nurseries the costs were much lower. At the Monument Nursery 2-year-old seedlings of yellow pine were raised at a cost of 50 cents per thousand; Douglas fir, at 86 cents; Engelmann spruce, at 50 cents; Austrian pine, at 42 cents; transplants of yellow pine, at \$2; Douglas fir, at \$1.67, and Engelmann spruce, at \$2.73.

COMPARISON WITH WORK OF PREVIOUS YEARS.—Last year practically the only commercial species of coniferous trees of which the seed crop was not below the average were western white pine and the Pacific coast Douglas fir. Because of this the amount of coniferous seed collected was about 4,843 pounds less than in 1911. The amount of coniferous seed purchased was 20,465 pounds less than in 1911, the reduction being mainly in exotic species, the use of which has in general been unsuccessful. Of hardwood seed, 17,979 pounds less than in 1911 were obtained.

The total area reforested was 4,687 acres less than in 1911. The area seeded was 8,866 acres less, while the area planted was increased from 1,995.47 acres in 1911 to 6,174 acres in 1912. The nursery stock ready for planting was first disposed of, and the balance of the funds available was used in seeding. The decrease in the area seeded is entirely within districts 3 and 5, in which, because of adverse conditions, the work has been restricted, and in district 6, where all the funds available were devoted to the collection of seed.

The total number of seedlings and transplants in all the nurseries is now 45,358,265 plants, an increase of 10,506,320 plants in the amount of nursery stock. This increase was due mainly to the fact that some nurseries were below their full capacity, so that the stock could be increased without increasing the cost of maintenance.

The coniferous seed collected by the service cost \$1.68 per pound, as compared with \$1.24 per pound in 1911, due to a poor seed year for most species and in spite of better organization and equipment. The hardwood seed collected cost 19 cents per pound, as compared with 11.6 cents per pound in 1911. Yet, in general, the cost of seed of the principal species is falling, as shown by the following table for district 2, which illustrates conditions in all districts:

Species.	1909		1910		1911	
	Seed collected.	Cost per pound.	Seed collected.	Cost per pound.	Seed collected.	Cost per pound.
	<i>Pounds.</i>		<i>Pounds.</i>		<i>Pounds.</i>	
Yellow pine.....	157	\$1.93	¹ 5,899	\$0.89	5,147	\$0.85
Douglas fir.....	194	2.53	1,583	1.72	2,679	1.14
Lodgepole pine.....	42	5.27	1,409	3.92	2,782	1.95
Engelmann spruce.....	3	5.27	417	3.21	449	1.93

¹ Exclusive of 23,769 pounds from the Black Hills, which were purchased.

When collection was first undertaken the cost of lodgepole pine seed was almost prohibitive on account of the high cost of extraction from the cones, while it can now be produced for less than \$2 per pound. Since the cost of extraction determines largely the cost of clean seed, this reduction is especially encouraging. The cost of extraction is being decreased not only by reducing operating costs per pound, but also by securing a larger quantity of seed per bushel of cones. From the following table for district 1, which is characteristic

also of practically every district, it may be seen that the cost of both direct seeding and planting has been decreasing from year to year:

Average costs of planting and direct seeding.

	1909		1910		1911	
	Spring.	Fall.	Spring.	Fall.	Spring.	Fall.
Planting-----	\$18.98	\$14.32	\$35.40	\$13.15	\$12.75	\$7.50
Direct seeding-----	11.30	3.48	3.36	3.35	6.65	3.80

The average cost of all planting fell from \$19.56 per acre in 1911 to \$11.05 in 1912 for both hardwoods and conifers, and to \$10.73 per acre for conifers, which include most of the acreage covered.

Further reductions in cost are possible, and will come through further cheapening of seed, nursery stock, and field operations. The cost of direct seeding shows comparatively little variation from year to year.

RESULTS.—The results from much of the early planting by the service were poor. On the whole, for the entire area covered on the national forests, reports indicate that about 50 per cent of all the trees planted are living. In some plantations under favorable conditions in Washington, Oregon, and Montana, 90 per cent of the trees planted are now living, but in others under the unfavorable conditions of the Southwest the percentage of living trees is very small. Better results in planting are being secured each year as better stock is being raised and the methods of planting are improved. During the year, even in Arizona, New Mexico, and southern California, where, on account of the extremely unfavorable conditions, success in artificial reforestation was almost despaired of, fair or even good results in small experimental areas have been secured. Good results in planting hardwoods were obtained during the year on the Ozark and Arkansas National Forests in Arkansas and the Wichita National Forest in Oklahoma. The success of direct seeding has been found to depend mainly upon the nature of the site, the preparation of the soil, the time of sowing, and the protection of the seed against rodents.

Some form of preparation of the ground has been found necessary to secure any reasonable degree of success. Broadcasting, except on prepared strips or upon recent burns, has not proved successful. The seed-spotting method has been most successful, particularly upon favorable sites, if done at the proper seasons. Late summer and early fall sowing have in general given best results.

In practically all cases it is necessary to afford some protection to the seeded areas against rodents. It has been found that a single poisoning is not sufficient, that the areas to be seeded must be selected a considerable time in advance, and that the poisoning must be done at regular intervals and over areas larger than will be sown. In general, the increased cost of poisoning is slight, and it provides a very cheap and effective insurance against the destruction of the seed. In Arizona, New Mexico, and southern California even the most careful direct seeding has in almost every instance, owing to the combined effects of drought, frost, rodents, and birds, proved

an entire failure. Direct seeding secured a fair stand in States like Washington and Oregon and in the Black Hills of South Dakota, where the climatic and soil conditions were on the whole favorable to tree growth.

Generally speaking, planting has so far yielded better results than seeding, especially on unfavorable sites, but planting experiments have been conducted for a longer period. From the standpoint of results, planting has been cheaper than seeding in many instances, although the initial cost of seeding is considerably less. Because of the smaller initial cost of seeding and the possibility of developing successful methods on favorable sites, a large amount of additional work in seeding under such conditions is justified.

Failures in reforestation were inevitable at the beginning. Without precedents, with a range of conditions varying from humid to arid, it was only through wide experimentation that methods could be developed which would secure results. In the light of the experience gained during the last few years, it is evident that additional progress along this line will be made only by careful, intensive methods which will mean, in case of direct seeding, preparation of the ground and getting rid of seed-destroying animals, and in case of planting, raising larger stock of sufficiently good root development to withstand trying climatic conditions. The lesson so far taught is that reforestation in the West, in order to be successful, must overcome many climatic and biological difficulties, which means intensive and expensive work. In general, the results of the past year have been the most encouraging since the work was begun, and indicate not only that planting is now a safe undertaking under favorable conditions, but that it is or can undoubtedly be made so under unfavorable conditions. It is hoped that still more successful methods of seeding for favorable conditions at least can be developed; continued efforts are certainly worth while. In both planting and seeding better results can in the future undoubtedly be secured at less than present costs.

FREE DISTRIBUTION OF PLANTING STOCK.—The agricultural appropriation act of March 4, 1911, provided for the free distribution of young trees from the Halsey Nursery, Nebraska National Forest, to settlers within the Kinkaid district.

Last year not more than 50,000 trees were ready for distribution. It is expected that 100,000 trees will be available in 1913. In 1914 and thereafter about 400,000 trees can be distributed annually. Not until 1914, therefore, can the free distribution to settlers be made on as large a scale as is desirable. Ninety trees were given to each applicant last year. It is hoped that in 1913 this number can be increased to 250.

A conservative estimate of the cost of 3-year-old trees is \$5 per thousand; of maintenance of the buildings and other equipment and of office charges, 50 cents per thousand; of preparing trees for shipment in small lots such as will be sent to individual settlers, \$2 per thousand; making a total estimated cost of \$7.50 per thousand.

At this rate the cost to the Government of the free distribution of planting stock to the settlers in Nebraska this year will be about \$375. In 1914 a distribution of 400,000 plants will cost \$3,000.

The species to be grown in the nursery are chiefly western yellow pine, jack pine, and Norway pine, which are likely to give the best satisfaction in the sandy region of the Kinkaid district.

FOREST INVESTIGATIONS.

Experimental studies were conducted in connection with the five important problems of reforestation, management, forest influences, protection, and mensuration. Besides forming a scientific basis for national forest management, the results of these investigations supply the knowledge necessary for the application of the principles of forestry to private timberlands throughout the West. Most of the investigative work was done at the experiment headquarters now established at various points on the forests. Each such station gives chief attention to the problems most typical of and most urgent in the district in which it is located. Thus the management and reproduction of western white pine and larch forests are being studied at the Priest River Station, in district 1; of the Douglas fir, lodgepole pine, and Engelmann spruce forests at the Fremont Station, in district 2; of the western yellow-pine forests at the Fort Valley Station in district 3; and of the sugar and yellow pine forests at the Feather River Station, in district 5. The latter station and the Priest River Station were established during the year. Facilities for the study of problems relating to the national forests in Minnesota and Michigan were secured by cooperation with the University of Minnesota in the establishment of a station at Cloquet, Minn. A fourth new station, the Utah, was established on the Manti National Forest after the close of the fiscal year.

During the year reforestation was the problem given first attention the greater number of experiments having to do with seed extraction nursery practice, and methods and seasons of sowing and planting.

Considerable progress was made in developing methods of extracting seed from the cones of both eastern and western species, and much valuable information obtained on the largest amount of seed that may be extracted from cones of different species per unit of time at different degrees of temperature, the maximum temperature which may be applied to seeds of different species without impairing their vitality, the germinating power of seed extracted at various temperatures, the comparative length of time required for germination of seed extracted with and without artificial heat, and the most economical type of extracting plant.

The source from which seed is collected was found to be of great importance. In general, the best results would be secured if seed produced locally could always be used in reforestation work.

As fast as the experiment stations were able to handle the testing of seed this work was transferred to them. During the year districts 1, 2, 4, and 6 carried on their own tests. The advantage is in having results available when needed, in developing methods of test which answer the particular needs of the district, and in furnishing activities for the experiment stations in winter, when other work is slack.

From the experiments in nursery practice much valuable information was secured as to the depth to which seed should be covered, the most efficient fertilizers for transplant and seed beds, the prevention of damping off of young seedlings, and the watering of plants in the nursery. It was shown conclusively that in all nursery work sowing at a depth greater than one-fourth inch is not advisable. Leaf compost and manure were found to be better than commercial fertilizers for transplant beds, while for seed beds the opposite was true. At

the Monument Nursery it was found that the use of dry soil on the surface of the beds and frequent cultivation reduced the loss from damping off. At the Halsey Nursery a system of chemical treatment to combat the disease is being worked out. While seed beds must be regularly sprinkled until germination is complete, indications are that the less water applied after that time the hardier will be the trees. Withholding water from seedlings may result in some loss in the beds, but the ultimate success in the field will more than balance this.

Experiments with different sites for reforestation point to the conclusion that sowing and planting should, as far as possible, be confined to the cool, relatively moist north or east slopes, until planting methods are better developed and the conditions affecting young seedlings more thoroughly understood.

A test of seed-spot sowing of western yellow pine, begun at the Fremont Experiment Station in 1911, showed the lightest covering of soil, one-fourth inch, to induce the greatest germination and survival. The percentage of survival alone, however, was somewhat greater with a one-half-inch covering.

Very promising results were obtained from sowing and planting maritime pine and cork oak on the Florida National Forest and at the Clemson Coast Experiment Station at Summerville, S. C. On the Florida Forest 7 acres sown to maritime pine in March, 1911, now bear a dense stand from 1 to 2 feet high. The cork oak, sown in the spring of 1911, has also done exceedingly well. These results clearly indicate the suitability of the two species to the climate and soil of the Southeastern States.

Good results in reforesting with introduced species were had with yellow pine, jack pine, and Scotch pine on the Nebraska National Forest, and with yellow pine on the Kansas National Forest, while lodgepole pine has been successfully introduced into the Pikes Peak region. Experiments are now under way with Austrian pine and Norway pine on the Nebraska, and with red cedar, jack pine, and Austrian pine on the Kansas Forest. Of the hardwoods so far tried, green ash and cottonwood are the most hardy. Honey locust seems more promising than black locust, osage orange, or walnut.

The vast brush fields on a number of the national forests of northern California, totaling roughly 1,500,000 acres, and the extensive bear clover or tar-weed areas of the central and southern Sierras, both largely the result of repeated forest fires, were studied during the year to determine the possibility of their reforestation. Other studies had in view the protection of planted areas from rodents and the development of methods to reduce the cost of planting.

The trend of experiments in forest management was toward determining the best silvicultural systems and degrees of cutting to secure natural reproduction, problems of the greatest importance in timber sales. These studies are carried on by means of permanent sample plots on which all the trees are carefully measured and recorded. The timber is cut under different silvicultural systems, or thinnings or improvement cuttings are made. An exact record is kept of the amount of timber removed and of the size and distribution of the remaining trees. Measurements taken at regular intervals will show the precise effect of the method used on each plot. A number of experimental cuttings and thinnings have already been

made, but none has been executed long enough to yield conclusive results.

The study at Wagon Wheel Gap, Colo., to determine the effect of forest cover on streamflow, described last year, yielded valuable records, although final results can not be obtained until after the denudation of one of the watersheds. Points of great interest already determined are that the surface run-off contributing to what may be called a flood in either stream is less than 1 per cent of the rainfall of any storm yet recorded; that the amount of soil erosion from the forested watersheds is practically negligible; that the relation of maximum flow to minimum flow in 1911 was about 13 to 1, while other watersheds of the region more sparsely covered usually have a ratio of from 20 to 1 to 100 to 1, and that the crest of a flood after heavy fall rains lasting 72 hours occurred in one stream in 2 days and in the other in 4 days, while neither stream had recovered its normal flow 2 months after the rain.

At the Fort Valley Station observations during the year upon the effects of forests on climate proved that the forest is very effective in checking excessive wind movement and evaporation. Conclusive proof will be sought of the influence of the forest in moderating low-temperature extremes.

A contribution of the Forest Service to the final report of the National Waterways Commission (S. Doc. 469, 62d Cong., 2d sess.) brought out an entirely new point of view as to the relation between the forests of the Coastal Plains and Appalachian Mountains and the humidity of the central and prairie regions.

The damage caused by light surface fires, which find some advocates among lumbermen, was the subject of investigation on a number of forests. A record of 1,184 butt logs on the Whitman Forest, in Oregon, showed 22.8 per cent to be more or less scarred, while 18.6 per cent lost an average of 46 board feet apiece by scale through fire damage, and many more were pitchy.

In cooperation with the Bureaus of Entomology and Plant Industry studies were conducted on a number of forests of insect infestation and tree diseases.

On the Klamath National Forest 927 acres were treated for insect infestation, the area protected by such treatment amounting to 29,000 acres, with a stand of 330,000,000 feet of timber, valued at \$660,000. The cost of combating the infestation amounted to \$3,000.

Attempts to eradicate the dendroctonus beetle on the White River Forest by cutting and barking infected trees and on the San Isabel by girdling did not prove entirely successful. On the Pike Forest, however, infestation was checked.

Studies of *Phoradendron juniperium* in burls of incense cedar, of *Hypoderma* sp. on shore pine, and of the age of infection of incense cedar with dry-rot were completed.

A pathological survey of the Mono, Tahoe, Eldorado, Stanislaus, Sierra, Lassen, Klamath, and Shasta Forests and the Yosemite National Park was made during the year. A manual of forest-tree diseases was prepared by the forest pathologist in California for the use of forest officers.

A study of the deterioration of fire-killed timber in Montana and Idaho showed conclusively that in western white pine blue stain and check set in almost immediately after a fire; that the blue stain is con-

ined to the sapwood; and that check is limited in extent and blue stain most severe in trees which retain their bark. Studies were begun to ascertain the difference between the net log scale and net number scale of fire-killed timber and to determine the effect of fire-killed timber in the reduction of grades.

Commercial tree studies of Douglas fir, lodgepole pine, western yellow pine in Oregon, western red cedar, and sugar pine were completed during the year. These studies cover the growth, volume, and yield of the tree and its utilization and life history.

RANGE MANAGEMENT.

Seven years of actual range administration has convincingly demonstrated the correctness of the fundamental principles upon which it is based by tangible and striking results. A maximum of forage production and a maximum of benefit to the stock industry and to the meat-eating public are combined with protection of other forest interests and with healthy community development. Overgrazing has been stopped, range productiveness raised, losses from predatory animals, poisonous plants, and contagious diseases of stock lessened, inaccessible range opened to use, and each class of stock assigned to the kind of range best adapted to it.

Appreciation by the stock growers of the fact that regulated grazing benefits them is steadily growing. The result is a strong bond of common interest and sympathetic understanding. It is now possible to solve, with satisfaction to both parties, many administrative problems which formerly gave trouble. Helpful cooperation and assistance is the return which the Forest Service receives for greatly improved conditions of live-stock production and assured permanence of the stock industry.

GRAZING CAPACITY OF NATIONAL FORESTS.

Of the 160 national forests in the continental United States on June 30, 1912, 3 produce so little forage that their use for grazing purposes is unprofitable. The remaining 157 were under grazing administration. The total number of domestic animals which may normally be grazed within these forests has now been closely determined and hereafter will remain fairly constant unless the areas of the forests are materially changed, except as improved conditions due to more intensive methods of range utilization and to fuller knowledge of range improvement problems make increases possible. The need for sweeping reductions to stop damage no longer exists.

The area under grazing administration at the close of the year was 346,000 acres less than at the close of the previous year. A much larger area was eliminated from the forest, but was offset by the addition of other lands. Upon lands added after the season had commenced no permits were required. Further, in many instances the use of lands, elimination of which was pending at the beginning of the grazing season, was allowed free of charge and without permit, while the lands actually eliminated included some of the best and most heavily stocked ranges. Nevertheless, the number of animals grazing under permit was very materially increased. Increased carrying capacity due to regulated grazing made this possible.

Numerous changes in the number and kind of stock authorized to occupy each of the national forests have followed more exact

knowledge of the kind of stock to which each range unit is best adapted, the period during which it may be used to the best advantage, and the number of stock it will support. Some grazing authorizations were increased, others reduced, but in most instances a reduction in the number of one kind of stock was accompanied by an increase in the number of another kind. The total grazing authorizations for 1912 were: Cattle and horses, 1,861,678; swine, 57,815 and sheep and goats, 8,502,816. These figures represent the estimated normal grazing capacity of all of the national forests and exceed the number for which permits were taken out.

Upon eight forests reductions in the number of stock authorized resulted in the exclusion of stock that had previously occupied the range. Reductions of this character totaled 4,300 head of cattle and horses and 64,000 head of sheep and goats. Upon one of these forests, the Manti, the reduction of 2,000 cattle and horses and 27,000 sheep was ordered in 1911, but was deferred until the season of 1912 to afford the stock growers an opportunity to dispose of the excess stock without loss. There are a few other forests where reductions to stop damage appear to be necessary, but it has been deemed best to defer these reductions until conditions become more favorable for the disposal of the stock which will be excluded. Reductions of this nature have not been initiated by the Forest Service alone, but almost always upon the request of the citizens who live upon or adjacent to the ranges and who believed the reductions were necessary to protect either their domestic or their irrigating water supply, or both. This was especially true in the Manti case.

There is some fluctuation in the demand for range, which may cause a temporary waste of forage resources within limited areas, but generally speaking, the only national forests which are not stocked to their safe grazing capacity are a few in northern California and central Colorado and those in northeastern Washington, northern Idaho, and northwestern Montana. In these forests there is considerable summer range suited to sheep grazing which may be used from three to five months each year. Most of it is difficult of access and remote from spring, fall, and winter ranges, and generally can only be reached by railroad shipments, so that despite the best efforts of the district officers much of it remains unutilized. There has, however, been an encouraging increase in the number of sheep grazed in the northwestern forests, and the results have been decidedly advantageous both to the Forest Service and to the sheepmen. As the railroads have signified their intention to grant satisfactory feed-in transit rates the prospects are favorable for a full utilization of the ranges. Summer feed for an additional 100,000 head of sheep may readily be secured in the forests of northern Idaho and northwestern Montana if these railroad rates are established.

RANGE CONDITIONS.

Throughout Colorado, South Dakota, Wyoming, northern Utah, eastern Idaho, and southeastern Montana the fall of 1911 was marked by a severe drought, and within this region the earlier promise of an abundant season did not materialize. With a forage crop much below normal the demand for range was augmented by the exceedingly unfavorable conditions upon outside ranges. Some extra stock was provided for, and except in a few isolated instances all stock under permit was in good flesh when removed from the forest ranges.

Throughout the remainder of the West range conditions during the same period were normal or better, and the ranges were in fair to excellent condition at the close of the season.

Within the region previously visited by drought the winter of 1911-12 was most severe. There was a pronounced shortage of winter feed, and heavy losses of stock occurred in Colorado, Wyoming, and southeastern Montana, notwithstanding that heavy sales had lightened the demand and that every effort had been made to provide adequate pasturage and winter feed. Conditions elsewhere were favorable except in Arizona, where drought and shortage of feed caused a heavy loss of ewes and lambs upon the desert ranges. California also suffered from drought, but early spring rains relieved the situation.

During the spring of 1912 exceptionally heavy falls of snow and rain continued until the approach of summer. Many of the lambing grounds were covered with deep snow when lambing began. There has been a gradually growing tendency to advance the date of lambing, and the severe storms during the lambing season caused a most unusual loss of ewes and lambs. Losses of ewes amounting to 20 per cent or more and lamb crops 25 to 33 per cent below the average were reported from northern Arizona, New Mexico, Utah, and Nevada. Cattle in the same region entered the forests in poor condition. In the coast States the spring season was favorable and no spring losses have been reported. After June 1 the weather became warm and clear, there was an abundance of moisture in the ground, and an unusually plentiful crop of forage developed.

A period of drought affords a searching test of the advantages of a regulated range. For a series of years the forest ranges have stood this test with credit. Within the region visited by the drought the forage productivity of the range was much below normal, and it was necessary to provide feed for many stock from depleted outside ranges; yet practically all stock left the national forests in fair flesh and generally in prime condition. The winter losses did not occur within the national forests. The spring losses were mainly due to the effort to lamb sheep upon open ranges when the climatic conditions make the operation hazardous at best. The heavy losses which occurred were the result of circumstances which can not be controlled, not of any defect in the administrative system.

Cattle prices reached new high levels during the year, while the prices of sheep and wool strengthened materially. The cattle industry has received a new impetus, and the demand for cattle range will inevitably increase. While many sheep changed ownership, they remained in the same locality, and there has been no marked diminution in the demand for sheep range. The prospects are that the demand for forest range next season will equal or exceed that of past years.

IMPORTANT CHANGES IN LIVE-STOCK INDUSTRY.

The beneficial results of range regulation and control have led the stock growers to improved methods. Permittees are voluntarily constructing many miles of drift fence to confine stock to the allotted ranges, are greatly increasing the quantities of salt placed upon the range, are making better provision for wintering their stock, are buying and breeding superior grades of stock, and finally are cooperating with each other in the handling and management of the stock

along lines which insure a minimum of damage and effort and a maximum of return.

Perhaps the most important change which is taking place in the industry is due to the curtailment of the unreserved and unappropriated range outside of the forests, partly through homestead settlement and other forms of alienation and partly through the deterioration resulting from misuse. Many outfits finding their customary ranges depleted, occupied, or rendered impossible of access, have endeavored to secure grazing privileges upon the national forests. The rapid appropriation of the choicest lands and areas which control large tracts of grazing land has emphasized the value of the national forest range, and there is a growing tendency to remove stock from the unreserved lands to the forest lands.

A few years ago cattle prices were low and the sheep industry was at the high tide of prosperity. Consequently many stock growers disposed of their cattle and engaged in the sheep business. More recently cattle prices have risen rapidly while sheep prices have slightly declined, and on some of the national forests there is a pronounced tendency to replace sheep with cattle. In the States where the sheep industry is dominant the trend is still from cattle to sheep. Except when disturbed by abnormal economic conditions the development of the live-stock industry within a given State is influenced largely by the natural suitability of the grazing lands for the production of a certain kind of stock, and the passing of the era of comparatively higher prices for mutton and wool is resulting in a more normal stocking of national forest ranges.

GRAZING TRESPASS.

Both innocent and criminal trespass have decreased. The new cases numbered 20 less than the preceding year. The following table covers all grazing trespass cases:

Year.	Cases pending beginning of year.	New cases during year.	Total cases.	Dismissed.	Prosecuted.	Settled, innocent.	Settled, willful.	Cases pending close of year.
1911.....	117	197	314	98	8	73	31	104
1912.....	104	177	281	40	49	115	17	60

The uniformly favorable court decisions have tended to decrease cases of willful trespass, and it is believed that this class of trespass will continue to grow less. Cases of innocent trespass due to carelessness of herders and other causes will, of course, occur, but it is anticipated that settlement of these will be easily secured without resort to court proceedings. The prosecution during the past year of herders and camp tenders for criminal trespass, whenever it was found they had acted in violation of the orders of the stock owners, followed by the conviction and punishment of several of them, has resulted in increased care and a decreased number of trespass cases of both kinds. Heretofore trespass proceedings have usually been brought against the owners.

In the case of the Newcastle Land & Live Stock Co. for a trespass upon the Sundance National Forest the jury, in addition to the value of the forage consumed by the trespassing sheep, allowed the Government a sum to cover the damage to forest reproduction. Since this is

the first instance in which such a jury verdict has been obtained, it establishes an important precedent.

ADVISORY BOARDS.

The Forest Service is in cooperation with 84 officially recognized live-stock associations, of which two are national in scope, one a State organization, and 81 local associations composed mainly of stock growers using the national forests. Sixteen new associations were recognized during the year. The men selected by the stock growers to represent them in their dealings with the Forest Service worked unselfishly and most effectively for the betterment of range conditions, and the service which they rendered was of great value.

Formerly organized primarily for the adjustment of differences with the Forest Service, the principal purpose of these associations is now constructive. The satisfactory adjustment of administrative problems has removed the need for stockmen to combine for the protection of their common interest against unfavorable methods of regulation, if such a need ever existed; but a steadily growing need exists for cooperation in the development of more advanced methods of range utilization and control. In working out these problems the Forest Service needs the assistance of the men who actually use the range. Matters of vital interest to large numbers of stock growers are involved. The local live-stock association with its officially recognized advisory board affords a medium through which each permittee may secure actual and effective representation in the working out of changes along the best lines. Fortunately there is a growing appreciation of this fact and the efforts made to secure the organization of permittees have been reasonably successful.

PERMITS.

Paid grazing permits were issued as follows.

Grazing permits issued and number of stock grazed under permit, fiscal year 1912.

State.	Cattle, horses, and hogs.				Sheep and goats.			
	Permits issued.	Number of stock grazed.			Permits issued.	Number of stock grazed.		
		Cattle.	Horses.	Hogs.		Sheep.	Goats.	To lamb.
Arizona.....	1,681	241,334	8,218	361	183	415,074	7,323	213,802
Arkansas.....	4	253						
California.....	2,521	169,361	10,403	3,480	367	429,413	15,235	3,561
Colorado.....	2,796	250,960	8,801		446	777,836	2,079	101,187
Florida.....	37	434		163	5	510		
Idaho.....	1,423	86,722	8,297		687	1,516,603		45,367
Kansas.....	108	10,712	220		1	233		
Michigan.....								
Minnesota.....								
Montana.....	1,924	115,681	15,306		388	686,388	1,270	20,499
Nebraska.....	112	43,140	1,660					
Nevada.....	369	56,937	5,638		105	495,533	1,400	18,030
New Mexico.....	1,813	103,537	5,960	252	629	425,976	56,288	241,374
North Dakota.....	9	332	128					
Oklahoma.....	30	4,039	184					
Oregon.....	1,400	85,413	11,959	74	565	885,210	9	46,882
South Dakota.....	401	9,917	2,173					
Utah.....	5,537	134,916	10,622		1,544	991,109		288,759
Washington.....	209	7,832	739		104	147,008		
Wyoming.....	814	81,505	5,026		289	696,997	250	79,525
Alaska.....								
Total.....	21,188	1,403,025	95,343	4,330	5,313	7,467,890	83,849	1,058,986

Compared with 1911, there were increases in stock grazed under permit of 51,103 cattle, 3,827 horses, 96,143 sheep, and 6,181 goats. The total net increase was 1.76 per cent. This taken in connection with the reduction in area already noted (p. 57) shows how regulated use and protection is augmenting the forage supply. The number of cattle and horse permits issued increased 3.37 per cent and sheep and goat permits over 4 per cent.

The average number of cattle and horses per permit was 70.7 head as against 70.6 head in 1911, and of sheep and goats 1,421 head as against 1,459 in 1911. These figures show that more users as well as more use are provided for.

The number of permits issued, by grades, in 1912 and 1911 are shown below:

CATTLE AND HORSE PERMITS.

	1912		1911	
	Number.	Per cent.	Number.	Per cent.
Grade 1, 1 to 40 head.....	14,042	66.27	13,419	65.27
Grade 2, 41 to 100 head.....	3,963	18.70	3,910	19.00
Grade 3, 101 to 200 head.....	1,749	8.26	1,735	8.35
Grade 4, over 200 head.....	1,434	6.77	1,435	7.00
Total.....	21,188	100.00	20,499	100.00

SHEEP AND GOATS.

Grade 1, 1 to 1,000 head.....	2,640	49.69	2,521	49.69
Grade 2, 1,001 to 2,500 head.....	1,990	37.46	1,923	37.46
Grade 3, 2,501 to 4,000 head.....	393	7.39	367	7.39
Grade 4, over 4,000 head.....	290	5.46	294	5.46
Total.....	5,313	100.00	5,105	100.00

Range stock holdings of less than 200 head of cattle and horses and 2,500 head of sheep or goats are counted small outfits. Over 92 per cent of the permits issued were for less than these numbers. The percentage of small permits was slightly greater than in 1911.

The percentage of approved applicants who failed to pay the grazing fees and utilize the privileges allotted to them was 8.3 per cent, an increase of 0.5 per cent over the previous year. This was due in part to the fact that many approved applicants were prevented by high prices from securing the stock which they had intended to graze under permit, and in part to the fact that many payments of grazing fees were deferred because of the late spring and the impossibility of utilizing the range until after the end of the fiscal year.

The approval of applications for the grazing privilege for five year periods, authorized upon 54 forests, has been discontinued upon 7 because of a lack of demand for applications of such character. Upon the remaining 47 forests only an insignificant proportion of the permits are based upon term applications. There is no general tendency to enter into agreements covering periods of more than one year, because stock growers feel assured of adequate range, certain of tenure, and freedom from excessive reductions. Many holders of term permits are voluntarily relinquishing them, preferring the greater freedom of operation obtainable under annual applications.

Except on forests where the system is now in effect, the approval of five-year applications will be authorized only when requested by 25 per cent or more of the permittees, by petition or through the medium of a recognized advisory board.

For the convenience of stockmen who need to cross national forest lands to reach grazing grounds outside of the forests, special driveways are established over which the stock may be driven under crossing permits. Many of these are extremely long and are used by large numbers of stock. They must be wide enough to furnish the animals the forage needed en route. The sheep driveways in the Coconino National Forest contain 105,000 acres; in the Tonto, 85,000 acres; in the Carson, 73,000 acres. The exterior boundaries are carefully marked, and rangers are detailed to accompany the stock on the trail and see to it that they are not unnecessarily slow and do not trespass upon the adjoining ranges. No charge is made for crossing permits, although they involve considerable administrative expense and a considerable aggregate of free forage in transit.

The total number of crossing permits issued during the year was 2,845, covering 5,174,052 sheep and goats and 89,877 cattle and horses. Crossing permits are not required for small bands of stock which are driven along public highways or which do not graze upon national forest lands en route.

USE OF PRIVATE LANDS.

The arrangement so successfully followed for several years, under which the owners or lessees of unfenced private lands within the national forests, on waiving exclusive use of such lands, receive a free permit for the number of stock which their lands would support under the regulations, was continued with some slight changes. Permits of this class numbered 1,482, or 217 more than in 1911. They covered 60,665 cattle and horses, an increase of 3,071, and 466,212 sheep and goats, an increase of 73,620. The acreage involved was 2,526,941, an increase of 108,741.

The cooperative agreement with the Atchison, Topeka & Santa Fe Railroad Co. was continued during the present year, the terms remaining unchanged. These lands lie within the Zuni National Forest, in the State of New Mexico, and permits issued by the railroad company for its quota of the grazing privileges were for 4,495 head of sheep.

The informal cooperative agreements with the Northern Pacific Railroad and with the Weyerhaeuser Land Co. were continued throughout the year with the same satisfactory results as heretofore. These companies took our estimate as to the capacity of their lands, and in the case of the Northern Pacific Railroad the same charge per head is made as our grazing fees, and the lands are leased to permittees who are entitled to graze upon the lands adjacent to them in the national forest.

PROTECTION AGAINST DISEASE.

Excepting scattered cases of blackleg and anthrax, practically no loss of stock from communicable diseases occurred within the national forests. All animals which have been exposed to infectious

or communicable diseases must be submitted to rigid inspection by representatives of the Bureau of Animal Industry and pronounced free from disease before they are allowed to occupy the fore-ranges. In this way the forest lands are protected from dangerous infection. The relations between members of the Forest Service and the Federal and State officers charged with the duty of enforcing quarantine regulations and stock sanitary laws continued thoroughly harmonious and closely cooperative.

No inspection of sheep was required within districts 1, 5, and 6. Lip-and-leg ulceration developed to a limited extent on the Custer Forest, in Montana, but quarantine was not considered necessary. Inspection of sheep and presentation of certificates showing freedom from disease was required upon the Durango, San Juan, Cochiti, Topa, Montezuma, Uncompahgre, and Rio Grande Forests, in Colorado; the Cache, Caribou, and Pocatello Forests, in Idaho; and a few forests in the States of New Mexico, Nevada, and Utah, excepting the Ashley Forest. Sheep scabies has been so thoroughly eradicated in Arizona and the lip-and-leg epidemic is so well under control in Wyoming that inspection was not deemed necessary in these States.

Inspections of cattle for mange were required upon the Fremont and Deschutes Forests in Oregon, the Kansas Forest in Kansas, and the Lewis and Clark Forest in Montana.

Texas fever occurs only within the Cleveland, Wichita, Arkansas, and Ozark National Forests, and within the two forests first named it is rapidly being brought under control. During the year the Forest Service assisted the Bureau of Animal Industry in the construction of a 6-mile extension of the quarantine drift fence along the international boundary line in southern California and in the survey of a right of way for an additional extension which will be 33 miles in length. The completion of this fence will prevent the movement of tick-infested cattle across the international boundary. Three grazing permits for 106 head of cattle and horses were canceled on the Cleveland Forest at the request of the Bureau of Animal Industry to strengthen the quarantine. It is anticipated that the Cleveland Forest will be entirely freed of Texas fever within a comparative short time. On the Wichita Forest the periodic dipping of permitted cattle was continued under the supervision of a representative of the Bureau of Animal Industry. The drift fences and dipping vats constructed during the previous year are fully accomplishing the purposes for which they were designed, and it is believed that the forest will be completely freed of ticks within a year or so. On the Arkansas and Ozark Forests no effective progress in tick eradication can at present be made, but the residents of these forests are awakening to the importance of this work and ultimately it is hoped to secure the hearty support and cooperation, after which steps will be taken to clean the forests.

PROTECTION AGAINST WILD ANIMALS.

Predatory animals harmful to live stock and game animals were killed by forest officers as follows:

Predatory animals destroyed, fiscal years 1911 and 1912.

State.	Bears.		Coyotes.		Mountain lions.		Lynxes.		Wild cats.		Wolves.		Wolf pups.		Total.	
	1911	1912	1911	1912	1911	1912	1911	1912	1911	1912	1911	1912	1911	1912	1911	1912
Arizona.....	15	22	288	196	33	62	10	3	110	89	16	12	---	---	472	384
California.....	37	12	743	478	5	3	15	2	193	160	3	2	2	---	998	657
Colorado.....	11	18	1,008	824	8	3	2	4	70	73	31	4	25	8	1,155	994
Idaho.....	25	35	1,328	1,010	1	7	3	3	52	82	21	21	---	20	1,430	1,178
Kansas.....	---	---	---	2	---	---	---	---	---	---	---	---	---	---	---	2
Minnesota.....	1	---	---	---	---	---	---	---	---	---	---	---	---	---	1	---
Montana.....	20	29	183	269	1	8	3	18	15	11	12	27	5	36	239	398
Nebraska.....	---	---	49	31	---	---	---	---	---	---	---	---	---	---	49	31
Nevada.....	---	---	137	66	1	---	---	---	5	1	---	---	---	---	143	67
New Mexico.....	33	9	250	94	28	21	23	30	77	26	67	33	11	13	489	226
Oklahoma.....	---	---	45	38	---	---	---	---	58	32	---	---	---	---	103	70
Oregon.....	23	11	743	517	4	6	4	7	108	53	3	18	---	11	885	623
South Dakota.....	---	---	33	71	---	---	---	---	---	12	---	2	---	---	33	85
Utah.....	2	19	1,289	671	2	3	3	5	125	83	11	4	---	19	1,432	804
Washington.....	40	20	83	9	3	3	4	2	19	7	---	---	6	---	155	41
Wyoming.....	6	3	308	502	2	---	5	11	38	7	8	6	20	53	387	582
Total.....	213	178	6,487	4,778	88	116	72	85	870	636	172	129	69	160	7,971	6,082

The total number killed was 23.7 per cent less than in 1911. The number of wolf pups killed increased 132 per cent, mountain lions 32 per cent, and lynxes 18 per cent; but 16 per cent fewer bears were killed, 26 per cent fewer coyotes, 27 per cent less wild cats, and 25 per cent less wolves. This is due not so much to a relaxation of vigilance as to a diminution in the number of animals. The losses of live stock from predatory animals are much smaller than before the service began to rid the forests of noxious animals.

The work of eradicating prairie dogs and other range-destroying rodents within the national forests was conducted throughout the year by the Biological Survey, except in a few forests where the Forest Service completed work initiated by it in previous years. Extensive poisoning operations were conducted by the Biological Survey on the Coconino, Cochetopa, and Pike National Forests, and by the Forest Service on the Rio Grande, San Isabel, Kansas, Leadville, and Nebraska Forests. There is still an enormous acreage of prairie-dog towns within the forests, and it will be necessary to enlarge the work greatly if the ranges are to be rid of these pests.

PROTECTION AGAINST POISONOUS PLANTS.

As in previous years, an earnest and successful effort was made to minimize the loss of live stock from poisonous plants. The work of determining poisonous species and of locating and marking areas where such plants occur in sufficient abundance to be harmful was extended with highly satisfactory results, and the loss of live stock was low as compared with previous years. Much of the present loss is avoidable, being due to carelessness in herding and a disregard of warning notices, or to the grazing of stock which is hungry and especially susceptible to poison upon areas where the poisonous character of the vegetation is readily apparent.

Arrangements have been made with the Bureau of Plant Industry for a study of plants poisonous to live stock in Montana. The Forest

Service will contribute toward the cost of the work by furnishing the buildings and pastures necessary for the prosecution of the study, and by paying the salary and expenses of one investigator.

FORAGE AND RANGE INVESTIGATIONS.

Further material progress in grazing administration now awaits fuller knowledge of range conditions. As the open range grows less the importance to the country of increased output from the national forest stock industry rises. Although the present monetary value of the forage utilized annually is very great, there is urgent economic need both for its more perfect utilization and for its augmentation. Neither can be effected without careful technical observations and exact scientific data. A close study must be made of the character and condition of all forest lands and their products; the character and extent of the damage to tree growths and watersheds which is caused by the presence of live stock within the forests; and the means of minimizing or preventing such damage; the extent to which forage resources are wasted or destroyed by present methods of utilization, and the ways in which the waste or damage may be reduced; the distribution and economic importance of all of the herbaceous plants occurring within the forests; the means of promoting the growth of economically valuable plants upon denuded areas by natural or artificial methods of reseeding; and new methods of handling stock by which the highest degree of beneficial use will be obtained.

The most important feature of the range investigative work at the present time is the completion of a general reconnaissance covering all grazing lands in the forests. This has for its object a kind of stock taking of the range resource as it now exists. Careful data are thus gathered concerning forage conditions and the various factors which govern production. During the year detailed reconnoissances were inaugurated upon the Manti and Minam Forests, and those initiated during the preceding year on the Coconino, Medicine Bow, and Targhee Forests were continued. The reconnoissance of the Deerlodge Forest was temporarily suspended during the last half of the year.

Several studies are under way to determine the amount and severity of the damage to forest reproduction caused by the grazing of different kinds of stock, the time and character of the injury, and its effect upon tree growth. Thus far the studies have been confined to the yellow pine type, but at the close of the year preparations were being made to extend them to the aspen and other types. The object of the studies is to collect authentic information upon which to base definite plans of management of stock grazing in different types of forest. The studies on the Coconino and Shasta Forests were continued, and new studies were initiated on the Malheur and Payette Forests. A general study of the effect of grazing upon erosion, stream flow, and purity of water supply was initiated just prior to the end of the year.

The study of the distribution, life history, and economic importance of the herbaceous plants growing within the national forests is increasing in importance. Over 4,000 specimens were collected and identified during the year, and economic notes for each species

were prepared. A considerable number of previously unknown species were collected.

Over 500 artificial reseeding experiments, conducted upon 85 forests, tend to prove that artificial reseeding of range lands is practicable only under the most favorable conditions and upon comparatively limited areas. The intensive study of means of regenerating depleted ranges by natural reseeding, conducted on the Wallowa Forest, was discontinued at the close of the season of 1911. The principles developed by this study are being given practical application upon a number of national forests. Upon the Hayden Forest the application of the principles is in accordance with a carefully prepared working plan which provides for studies of the effect of alternate grazing, limited grazing, and total exclusion of stock.

The study of the relation of soil acidity to the growth of plants continued throughout the year.

The experiments within the coyote-proof pasture on the Wallowa Forest were completed at the close of 1911, having fully demonstrated the advantages of this method of handling sheep, and the pasture has been turned over to the Biological Survey, which has stocked it with elk. The study to determine the practicability of using small coyote-proof inclosures in connection with range lambing grounds was continued, with results strongly confirmatory of previous findings. The saving which is effected by the reduction in the amount of labor required and in the loss of sheep more than offsets the cost of the construction and maintenance of the inclosures. The inclosures will be maintained for a number of years to serve as examples to stock growers, and observations will be made each year. No other detailed experiments to determine improved methods of handling stock were carried on during the year, but general observations were made and plans were prepared for future studies of methods of using range without water for sheep grazing; of the most effective and economical methods of developing stock-watering places upon forest lands; of methods of reclaiming mountain meadows depleted by erosion; of improved methods of handling sheep; of methods by which the grazing capacity of forest lands may be determined with more exactness; and of the extent to which the grazing of stock minimizes the fire risk. Adequate prosecution of the range investigative work calls for a larger force than could be employed with the funds available.

GAME PRESERVATION.

There were no additions during the year to the number of game refuges or preserves within the national forests, nor was there any material change in the status of those previously existing, viz, the Wichita and the Grand Canyon national game refuges and the various State game preserves located within the Bighorn, Boise, Gallatin, Monerey, Minnesota, Superior, Teton, and Targhee National Forests. The majority of the forest officers engaged in administering these areas hold commissions as deputy State game wardens and effectively assist State officers in enforcing the local game laws. Throughout all of the national forests a vigorous effort was made to protect the game animals and birds from slaughter and molestation within their natural breeding grounds, while the destruction of predatory animals

and the regulated grazing of domestic live stock favored game preservation. The activities of the service contributed largely to the success of the movement to protect and perpetuate all species of game birds and animals.

No attempt has been made to stock the Grand Canyon game refuge with introduced species, and the only game animals within the refuge are those indigenous to the locality, which have multiplied encouragingly.

The buffalo herd on the Wichita, which when introduced in 1907 numbered 15 head, now contains 39 head. Nine calves were born during the year. The herd is in thriving condition, the buffalo having become thoroughly adapted to their new environment. No losses occurred. The elk herd was increased by 8 head shipped from Jacksons Hole, Wyo., in March, 1912, but 3 of these animals died shortly after their arrival at the refuge, presumably from injuries received in transit. The herd now numbers 12, of which one is a calf born in 1912. Like the buffalo, they are in splendid physical condition and free from Texas fever. The attempt to introduce antelope has met with poor success, although the country formerly was an antelope range; only 2 head survive out of a total of 10 placed within the inclosure. The cause is not definitely known. Additional animals will be secured if possible. Introduced wild turkey are doing well and give promise of large increases. The native deer are increasing rapidly, as are the quail and other native game birds. The nature of the Wichita game preserve makes it most interesting, and it is visited annually by a large number of people.

The Biological Survey cooperated with the Forest Service in stocking national forests with elk shipped from Jacksons Hole, Wyo. In addition to the 8 head placed on the Wichita, 14 head were placed in the Billy Meadows grazing experiment pasture in the Wallowa National Forest, and 20 head were liberated within the Sundance National Forest in Wyoming. It is hoped that the natural increase of these small bunches will ultimately stock the forests in question. Other shipments of elk were distributed by the States of Montana and Wyoming to points where the animals will range chiefly within national forests.

Stockmen, especially sheep owners, are uneasy lest the location of small bands of elk in ranges now utilized for stock grazing will, as the elk increase in numbers, eventually result in exclusion of stock. Game animals as they increase in number must be provided with more and more range or else suffer for food. It is believed that future shipments of elk for such purposes should be made only to those forests which either are not available for stock grazing or are natural game regions, more or less stocked with game at the present time. Under such a plan specific areas of limited extent, which are relatively undesirable for domestic stock, would be given up to game, thus re-establishing them in regions naturally well adapted for them, and perhaps opening the way to the breeding of game as an auxiliary meat supply, but without compelling any material curtailment of the stock industry. Such a system would entail provision for utilizing the increase of the game animals above the number which the range given over to them would support, otherwise the game would propagate only to starve.

The migration of elk during the winter season into the national forests surrounding the Yellowstone National Park, when the snow in the park compels them to seek food elsewhere, creates conditions that call for action. Three parties are concerned with the problem: (1) The State, represented by the State game warden; (2) the park authorities, who control the major portion of the ranges used by the elk during the summer season; and (3) the Forest Service, which controls a large part of the range used by the elk during all seasons. A census of the elk in the entire Yellowstone region was taken during the past summer. With this as a basis it is hoped to secure cooperation of the three authorities concerned in order that a definite policy for the future handling of this rather interesting problem may be formulated.

Fish secured from the Bureau of Fisheries have been used to stock streams within a number of the national forests, and this phase of game preservation receives increasing attention.

WATER DEVELOPMENT AND DRIFT-FENCE CONSTRUCTION.

Full utilization of the range resource requires that much should be done to make water available for stock and to control their movements by the construction of fences. Both classes of work constitute permanent improvements of the forests, and are reported on under that head; but occasion may appropriately be taken at this point to present, as a part of the general grazing policy, certain considerations which apply to these classes of improvements. For details, reference is made to page 72.

Since grazing on the national forests will evidently be permanent, improvements to increase their usefulness for this purpose should be made with this fact in mind. The Government owns thousands of springs, seeps, and watering places which are used by the stock grazed on the forests, and its water supplies should be systematically and methodically developed until every forest watering place needed is in good shape. Money spent in such improvements will be amply repaid in the form of increased range use.

On many forests permanent drift fences would greatly increase the carrying capacity of the range. Such fences would often quickly pay for themselves through increased receipts. They are so desirable that stockmen are in many instances ready to build them at their own expense. This, however, experience has proved to be not altogether a satisfactory plan, for the reason that if administrative needs call later for a change or removal of the fence or other improvement, or for any diminution of use of the range by the stockman who built it, friction and discontent follow. A definite amount should be assigned each forest each year for these improvements.

SPECIAL USES OF LAND.

USE FOR WATER-POWER PURPOSES.

The water powers found within the national forests will ultimately be of great value to the country. It is estimated that there is approximately 12,000,000 horsepower which can be developed from natural stream flow. This amount can be greatly increased through

the regulation of stream flow by storage. Numerous excellent reservoir sites are available.

The regulations adopted by the department on December 28, 1910, have now been in force long enough to demonstrate their practicability. On the whole, they are favorably received by developers. The propriety of making a charge for the use of the land occupied and the reasonableness of the amount fixed by the regulations is generally conceded. That feature of the permit which requires development to be made within a reasonable time is working satisfactorily and is serving to keep out speculators who have hitherto sought to appropriate sites only that they might later dispose of them to the real developer.

The following table shows the extent to which water-power development is taking place on the national forests:

	Trans- mission lines only.	Reser- voirs, conduits, power houses.		Trans- mission lines only.	Reser- voirs, conduits, power houses.
Permits in force June 30, 1912:			Permits issued from July 1, 1911, to June 30, 1912:		
Commercial—			Commercial—		
Preliminary.....		39	Preliminary.....		29
Final.....	73	84	Final.....	22	26
Noncommercial.....	5	62	Noncommercial.....		16
Total.....	78	185	Total.....	22	71
Projects operating June 30, 1912:			Applications received from July 1, 1911, to June 30, 1912:		
Commercial.....	60	56	Commercial—		
Noncommercial.....	4	28	Preliminary.....		46
Total.....	64	84	Final.....	20	25
Projects on which construc- tion had begun June 30, 1912:			Noncommercial.....	3	21
Commercial.....	6	29	Total.....	23	92
Noncommercial.....		16			
Total.....	6	45			

Much dissatisfaction exists with that provision of the act of February 15, 1901, which authorizes the revocation of permits at the discretion of the Government. It is urged that on account of this clause great difficulty is experienced in obtaining capital for developments, and that when it is secured it is only on terms of most liberal returns to capital. This ground for apprehension should be removed through legislation authorizing term permits, revocable only for breach of the conditions set out in the permit. There seems to be some doubt whether the existing law fully protects a power permittee against a later appropriator of the same land under the mineral or other public-land laws. All doubt on this question should be removed. Land once appropriated for power development should not be subject to any further appropriation which will interfere with the power use.

Stream measurements were made on various national forest streams in cooperation with the Geological Survey. Gauges which had been installed under the direction of the Geological Survey were read regularly by forest officers, who forwarded to the survey the data thus obtained. Unfortunately the survey was unable to continue the work owing to the lack of an appropriation.

OTHER SPECIAL USES.

At the close of the fiscal year there were in effect 13,810 permits authorizing the occupancy of small tracts of forest lands for a variety of purposes. The greater number of these permits are obtained in connection with other uses of forest resources. Thus stockmen obtain them for pastures for stock which can not be allowed to run on the open range, as well as for cabins, corrals, water tanks, and dipping vats used in caring for range stock; agricultural settlers require the use of small areas for irrigating reservoirs and conduits; and lumber operators secure suitable sites for mills and camps. With the construction of new roads and trails the forests are visited more and more for recreation purposes, and in consequence the demand is growing rapidly for sites on which summer camps, cottages, and hotels may be located. In some of the most accessible and desirable localities the land has been divided into suitable lots of from 1 to 5 acres to accommodate as many visitors as possible. The regulations of the department for handling this class of business seem to be entirely satisfactory. Permits are issued promptly and on conditions with which permittees willingly comply.

Some objection is heard to the fact that the permit is revocable in the discretion of the department. If occupancy of lots wanted for summer camps, cottages, and hotels for a period of years could be authorized, more substantial buildings than are now being erected would probably be put up.

PERMANENT IMPROVEMENTS.

The permanent improvement work on the national forests, including cooperative improvements, carried onward the plans which, as explained in previous reports, have been worked out for the orderly equipment of each forest with the facilities demanded for its protection and development. The main effort in 1912 continued to be the pushing forward, to the utmost extent permitted by the funds available, of construction work upon a primary system of trails, telephone lines, and lookout stations which will facilitate protection from fire. The result was to bring the total of construction since this work began up to 13,435 miles of trail, 11,182 miles of telephone line, and 265 lookout stations. There were constructed 190 houses, 186 barns, 328 other buildings, 243 miles of administrative fence, and 53 miles of stock fence.

In cooperation with counties, associations, and individuals there were built 85 miles of road, 153 miles of trail, 219 miles of fire line, 368 miles of telephone line, 65 miles of telegraph line, 32 miles of fence, 33 bridges, 3 corrals, 6 water improvement projects, 7 miles of stock driveway, and 22 stock tanks and dipping vats.

The following table compares the accomplishment in the more important lines of improvement work for 1912 and 1911. In considering the table it must be borne in mind that the appropriation for permanent improvements for the fiscal year 1912 was \$500,000 as against \$275,000 for 1911. The highest percentages of increased construction were for trails and telephone lines.

Projects.	Number of miles of projects.		Percentage of 1912 increase or decrease in amount done.
	1912	1911	
Trails.....	3,480	1,383	152
Telephone lines.....	3,936	1,427	176
Lookout stations.....	150	91	65
Fire lines.....	219	163	34
Roads.....	231	125	84
Bridges.....	114	50	128
Fences.....	296	376	—21
Corrals.....	70	47	49
Water improvement.....	243	185	31
Houses, barns, and other buildings.....	704	372	89

The estimated present value of all improvements on the forests, on the basis of what it would cost to replace them, but with allowance for depreciation, is \$2,791,308. This is considerably more than the total of all sums ever appropriated by Congress specifically for both construction and maintenance of permanent improvements. A good deal of improvement work was done before provision for it under a separate appropriation clause began; but the chief reason why the value of the property on hand is largely in excess of the sums specifically allotted for this work is the large extent to which the time of rangers and guards is utilized in constructing and maintaining improvements. Thus much of the money which it is necessary to spend for general administration and protection serves at the same time to increase the equipment on the forests.

Every forest supervisor is keenly alive to the great importance of more roads, trails, and other improvements, and is quick to seize every opportunity to employ his men in this work in all free intervals and to combine protective and development work. Men who are watching the forests for fire protection can at the same time be utilized largely in trail building and similar work. As has been explained in earlier reports, carefully prepared plans contemplating the complete equipment of every forest with the facilities needed for its best protection and use are in each supervisor's office. These plans distinguish between the primary and the secondary system, and classify the primary work in the order of importance of the various projects to be undertaken. The primary system is that fundamental to safety and efficiency under existing conditions. The secondary system is supplementary, to provide for intensive development and use. Even the primary system is no more than fairly begun. The immediate needs of the forests call for 80,000 miles more of trails, 40,000 miles more of telephone lines, and many other improvements. It is of the greatest importance that the extension of the system of improvements be urged forward with all speed, and there is no more crying need for larger provision of funds by Congress for national forest work, in the interest of protection and development of a vast property, than that created by this line of activity.

ACQUISITION OF LANDS UNDER THE WEEKS LAW.

The first full year's work under the Weeks law resulted in the general approval for purchase by the National Forest Reservation Commission of 255,822 acres of land. Because of unavoidable delay in

executing certain purchase agreements following action by the commission, 30,470 acres of this amount could not be contracted for before June 30, 1912, leaving a net total covered by purchase agreements during the year of 225,352 acres. The lands approved by the commission during the fiscal year 1911, amounting to 31,876 acres, proved not to have title acceptable to the Government. The purchase agreement for this reason failed, and the lands were brought under condemnation. The total area in process of acquisition by purchase or condemnation at the close of the year 1912 was 257,228 acres.

These lands are situated in eight separate purchase areas in New Hampshire, Virginia, Tennessee, North Carolina, and Georgia. In all, 18 such areas have been designated. They comprise 6,383,000 acres, situated in the above-named States and in the States of Maryland, West Virginia, and South Carolina. These areas have been selected on the basis of the topographic maps of the United States Geological Survey and the field work done by the Forest Service in the Appalachian region during the past 12 years. They were selected by the Forest Service, with the approval of the Secretary of Agriculture, and all occupy situations of controlling importance on the watersheds of navigable streams.

The Forest Service has also been authorized by the Secretary of Agriculture to receive offers of land under the Weeks law as well as to examine, appraise, and recommend to the National Forest Reservation Commission for purchase such lands as it believes should be acquired.

It is unnecessary to acquire all of the land within the designated areas. In some probably not more than half of the acreage should ever be recommended for purchase. Many valleys of fertile agricultural lands are included which it would not be wise to acquire. It will probably not be necessary even to acquire all of the mountainous nonagricultural lands within the areas. There is every reason to believe that the purposes of the Government may be fully subserved by the acquisition of compact bodies each containing from 25,000 to 100,000 acres well situated for protection, administration, and use. These bodies may be separated from one another by a distance of from 10 to 25 miles or more. With careful protection from fire and with the introduction of conservative methods of logging they will become demonstrations of practical forest conservation. It will doubtless be practicable to cooperate with surrounding private owners in fire protection and conservative lumbering, and thus in the end to bring most of the Appalachian region to a high state of forest productivity. To bring about this result it may be necessary to designate additional purchase areas, but at this time it does not appear that it will be necessary to acquire more land than the 5,000,000 acres in the Southern Appalachians and 600,000 in the White Mountains, which was stated in the report to Congress by the Secretary of Agriculture in December, 1907, to be all that would need to be acquired.

As a result of the invitation for proposals of lands within the purchase areas 2,102,330 acres have been offered for the consideration of the Government. During the year the Forest Service examined 665,891 acres, all lying within the several purchase areas. With 174,562 acres examined during the preceding year the total area examined prior to June 30, 1912, was 840,453 acres.

Within the purchase areas the selection of the most suitable lands for purchase presents a problem of much importance. It will not do to acquire small scattered tracts, since they can neither be administered nor utilized advantageously. It is necessary first of all to ascertain that a tract of at least 15,000 to 20,000 acres in a body and of the right character of land can be obtained. Other considerations to be kept in mind are the strategic importance of the lands with respect to economy of administration and the protection of the whole watershed, their relative value for timber production and prevention of erosion, their freedom from ownership complications due to defective titles, or mixed ownership on account of alienated water power, timber or mineral rights; and whether the lands can be bought at reasonable prices.

The Secretary of Agriculture announced during the year that no optioned lands would be considered. This action was made necessary by the activities of certain individuals who sought to precede the Government and tie up the desired lands by options in the hope that they might themselves sell them to the Government at a handsome profit. With the refusal absolutely to consider such lands no further trouble of this kind arose.

Lands are appraised as a result of a careful field examination made for the purpose of ascertaining the kinds, quantity, and quality of timber and the character and quality of the soil. Timber values are reckoned on the basis of present cost of operating and market prices, with due allowance for risks and profits. When the Forest Service has determined the value of a tract, negotiations are taken up with the owner for the purpose of obtaining an option at a price not greater than the value of the land as shown by the estimate. The option is usually taken for a period of from three to four months—long enough to give the National Forest Reservation Commission time to consider and act upon the recommendations of the Forest Service for the purchase of the tract. After approval by the commission a purchase agreement is entered into by the Secretary of Agriculture and the vendor.

All lands on which condemnation proceedings have been instituted or which are brought under purchase contract are surveyed by the Forest Service by horizontal measurement and the acreage thus ascertained is used as the basis of payment. In many cases in the Appalachian region lands have never been accurately surveyed, or if they have been surveyed it has been by surface measurement. Frequently the actual acreage found is less than that reported; in some instances the shrinkage amounts to from 8 to 10 per cent. It is impossible to ascertain with great accuracy what liability has been incurred in any purchase until the land has been surveyed and the title has been examined. It will consequently be difficult if not impossible to utilize closely during any fiscal year the funds appropriated for that year. The action taken by Congress to make available until expended the funds yearly appropriated under this act will aid substantially in working out the purposes of the law.

The lands placed under purchase contract or condemnation proceedings during the year are partly cut over, partly more or less culled of their best timber, and partly virgin timberland. The average price is \$5.95 per acre, with a range of from \$1.16 to \$15 per acre.

In the tracts being acquired the Government obtains lands which are believed to be of relatively large influence in the protection and control of navigable streams. Some are highly valuable for timber production; others are less so on account of the burned and impoverished condition of the soil; but all of them are so situated as to be of great value as demonstrations of forest conservation. The educational value of these lands in some instances will, it is believed, be as important a consideration as any other, since they will set up a sharp contrast in the several localities between a Government forest systematically cared for, developed, and utilized and forests heedlessly cut over, burned, and neglected.

Congress has appropriated funds for the protection and administration of all lands acquired. They will be put under systematic management with the object of improving their regulative effect upon streamflow and of increasing their products for use.

STATE AND PRIVATE COOPERATION.

Work in cooperation with States and private timberland owners comprised cooperation with States in fire protection under the Weeks law, field investigations in cooperation with States, and field studies and a small number of examinations of timber tracts to furnish the basis for advice to owners concerning better methods of management.

COOPERATION WITH STATES.

Cooperation with States in protecting the forested watersheds from fire was continued under the provisions of section 2 of the Weeks law, which appropriated \$200,000 for the work. Almost two fire seasons have passed since the law went into effect.

Watersheds protected include such as the Penobscot, Kennebec, Connecticut, Merrimac, Hudson, Delaware, and Potomac, in the Northeast; the Mississippi, in Wisconsin and Minnesota; and the Columbia and Willamette, in the Pacific Northwest.

The effectiveness of patrol and other protective features has been demonstrated by the small area within these watersheds burned over in the fire season of 1911, which scarcely exceeded 250,000 acres, as contrasted with enormous losses in some States in previous years.

The States are by no means equipped to handle the forest-fire problem alone, and where navigability of streams may be affected the Federal Government may well lend its aid. Many difficulties arise in connection with the handling of this problem by the States which are not encountered on the national forests because of the uniform ownership and policy obtained under Federal administration. In other than public-land States nearly all forest lands, especially in the States east of the Mississippi River, are held by private individuals. The average private owner is surprisingly indifferent to the need or value of forest-fire protection, particularly on cut-over lands. Even where this appreciation is not wholly lacking there is often an unwillingness to cooperate with other owners or with the State.

There is an exceedingly close relation between this cooperative protection and the protection given the national forests and the areas purchased under the Weeks law. Wherever possible the former supplements the latter, thus lessening in a large measure the danger of fire reaching the forests or purchase areas from outside.

It has been the purpose of the Forest Service in the allotment of the fund provided under the Weeks law to secure the greatest educational benefits by promoting State and private protective work in as many different States as possible. In the furtherance of this policy the maximum allotment made to any State has been limited to \$10,000. Allotments in each case are based upon the number and importance of navigable watersheds, placing a broad interpretation upon the term "navigable" and using as a general basis of determination the reports of the Chief of Engineers of the United States Army; the extent and value of the forests; the amount of the State appropriation and the ability of the State itself to do the protective work needed; and the amount of cooperation which can be secured from private owners.

In all cases a reasonable effort on the part of private owners is required. The provision of the law that cooperation shall not be extended to any State which has not provided by law for a system of fire protection has been interpreted and applied as requiring a field protective organization. States depending upon volunteer protection or upon the services of ex officio wardens with optional county expenditures have not received allotments. State appropriation for the protection of navigable watersheds equal to Federal expenditures by fiscal years has been required.

The following statement shows the allotment by States for the calendar years 1912 and 1911 and the expenditures during 1911. The unallotted balance of the \$200,000 fund available on September 1, 1912, was \$83,706.45.

State.	Calendar year 1912, allotment.	Calendar year 1911.		
		Allotment.	Expenditures.	Unexpended balance.
Maine.....	\$10,000.00	\$10,000.00	\$9,991.80	\$8.20
New Hampshire.....	8,000.00	7,200.00	6,219.50	980.50
Vermont.....	2,000.00	2,000.00	1,218.00	782.00
Massachusetts.....	2,500.00	1,800.00	365.00	1,435.00
Connecticut.....	1,500.00	1,000.00	6.00	994.00
New York.....	4,000.00	2,000.00	2,000.00	-----
New Jersey.....	2,000.00	1,000.00	990.00	10.00
Maryland.....	2,000.00	600.00	261.00	339.00
Wisconsin.....	5,000.00	5,000.00	4,437.25	562.75
Minnesota.....	10,000.00	10,000.00	10,000.00	-----
Oregon.....	10,000.00	5,000.00	3,305.00	1,695.00
Washington.....	10,000.00	-----	-----	-----
Montana ¹	3,500.00	-----	-----	-----
Idaho ¹	27,000.00	-----	-----	-----
Total.....	77,500.00	45,600.00	38,793.55	6,806.45

¹ Agreements not executed because of a favorable fire season.

² The expenditure of \$3,000 is conditioned upon the State's extending its present organization.

Cooperation has also been considered with Kentucky, Alabama, and California. At the last session of the Kentucky Legislature a forest law was passed which provided for a forest fire-protective system and made an appropriation for its maintenance. A tentative allotment of \$4,000 was set aside and will be made available as soon as the State can organize its forest force. It was found necessary to postpone cooperation with both Alabama and California because in neither of these States was there in operation an adequate State fire-protective system, nor were there funds to permit of systems being organized

under present laws. The Forest Service has desired to extend cooperation to many other States, but has been prevented from doing so by their failure to meet the requirements.

To insure the efficient expenditure of the funds allotted, each State, before the beginning of the fire season, has been required to submit a protective plan showing the watersheds to be protected, and in detail the part to be taken by States and private owners and the manner in which Federal funds are to be used to supplement or complete the system of the State and private owners. As rapidly as necessary permanent improvements and other conditions will allow, the expenditure of Federal funds is being restricted to the employment of patrolmen or lookout watchmen. This plan increases the effectiveness of the work and simplifies field inspection, auditing, and accounting. The service is manning lookout points as rapidly as they are located and equipped by the States.

So far as men are available, the protective work within each State is inspected annually. The results and conclusions secured from such inspection are furnished to the State authorities. The intensive study of all State organizations during the year makes it possible to acquaint each State with the best methods which have been developed in all others. Authority is reserved by the Government to cancel cooperation where inefficient work is found, or to terminate the services of inefficient men. As rapidly as practicable, railroad patrol by Federal patrolmen is to be restricted, since such patrol is held to be properly the duty of the railroad companies. State foresters are urged and required to secure the maximum of assistance from railroad companies. During favorable seasons, when it is possible to reduce the number of patrolmen and accordingly the expenditures for fire protection, States are required to reduce Federal and State expenditures proportionately.

To insure exactness in the method of expenditures and to prevent misunderstanding as to the condition governing cooperation, the work in each State for each year is covered by a cooperative agreement between the Secretary of Agriculture and a State official. To supplement the inspection of Federal officers, to give the fullest possible opportunity of understanding the plan followed by the State, and to insure the adoption during succeeding years of all improved methods of protection, a full report on results secured is called for from each State at the end of the fire season.

The benefits already derived from expenditures under this act can not be overestimated. Greater interest in fire protection has been stimulated in all the cooperating States. This is shown in the enactment of better laws, in appropriations, and in much more efficient fire protection. The educational value of the work is very great because of the close contact of Federal and State patrolmen with the people. During the year 1911 alone Federal patrolmen in New Hampshire were able to warn 4,200 people against carelessness in the use of camp fires.

In general, cooperation with the States has resulted in more efficient protective systems, in permanent organizations which make use of lookouts and telephones for the prompt discovery of and quick communication regarding fires, and in the abandonment of old, inefficient methods of voluntary service, and services by ex officio wardens, and uncertain action by counties and municipalities.

The requirement that in addition to State appropriations and a State fire system individual timberland owners cooperate with the Federal Government and the State has resulted in much closer relations between the States and private owners, and greatly increased expenditures for fire protection, both for the services of patrolmen and lookouts and for the construction of permanent improvements, such as lookout stations, telephones, trails, and similar advantages.

The cooperation with the State of New Hampshire furnishes a good example of the relative expenditures developed under the act. Over the entire State the Federal Government expended \$6,219.50, the New Hampshire Timberland Owners' Association \$8,800, and the State \$13,486.01. In the northern district of New Hampshire, with an area of approximately 1,000,000 acres, a total of \$14,000 was expended, an average rate of something less than 1.5 cents an acre.

The appropriation has resulted in great benefits in conservation of forest resources. On the average every dollar expended by the Federal Government has resulted in an expenditure of at least \$2 or more by the State and private owner, and the ratio will increase as the benefits of protection are more clearly realized. It is of great importance that the appropriation for cooperation with the States in fire protection be continued. The present appropriation will be exhausted by January 1, 1914. An additional appropriation of \$200,000 to be available until spent, so that the work may be continued without break, is urgently needed.

A study of forest conditions in Porto Rico was made at the request of the insular Government. This was coordinated with the work initiated on the Luquillo National Forest. The Luquillo National Forest was created primarily because of its importance to the surrounding territory as a water protective area, to insure the production of a perpetual supply of wood, and to encourage private owners and the local government by example to take up work in forestry. The population of the area surrounding the forest is very dense and the demand for wood, which at the present time is supplied largely by imports, is correspondingly great. As a result of the study it is proposed first that a survey shall be made of the forest in order to settle finally the title to a considerable part of the land about the ownership of which there is now much doubt. It is believed that this survey will show that the Federal Government owns an area of at least 20,000 acres; and the insular Government has expressed its willingness to convey to the Federal Government as an addition to the forest the adjacent areas which it owns. If these surveys show, as they undoubtedly will, that an area exceeding 20,000 acres can be held, a forest administration will be established and permanent improvements begun in order to make available for use the timber which at the present time is largely or altogether inaccessible.

Immediately following a field study of the entire island a concise preliminary report concerning the forest problems, with suggestions as to methods of handling them, was prepared for the immediate use of the board of commissioners of agriculture in their recommendations to the Legislative Assembly. Extensive forest planting must form a large part of any operations of the insular

Government on account of the small area in forests. Little is known of the native species or of the adaptability of exotic species except for ornamental planting. A large amount of systematic experimental work will consequently be necessary to determine what species are suitable for commercial forest planting. The chief recommendation of the preliminary report concerned legislation providing preferably for the creation and maintenance of a forest experiment station, a technical forest director, and an initial appropriation of \$18,000, or for a smaller appropriation covering the salary of a forester and his necessary office and incidental expenses as a means of carrying on preliminary advisory and publicity work. While the board of commissioners of agriculture as a result of these recommendations included in its budget to the 1912 legislature, then in session, an item of \$18,000 for forestry use, it failed to receive the approval of the committee on finance.

The preliminary report has been published by the board of commissioners of agriculture. A final and much more complete report is being prepared.

A preliminary examination of the forest conditions in Louisiana, the results of which were prepared for publication during the year, showed the principal forest problems to be those resulting from overproduction of lumber, forest fires, grazing, taxation, and turpentine. Suggestions were made for the development of an adequate forest fire protection system, more rational lumbering methods, both on the large holdings and farm woodlots, forest planting, and the conservative management of State lands. Considerable legislation has resulted, but, without appropriations, is inoperative. The constitutionality of the timber-tax provision of one of the latest acts designed to produce funds for work in forestry is now being tested in the courts.

As a result of a cooperative study begun in the summer of 1907 with Kentucky, and continued in 1908 and 1909, an appropriation was made and a forest law was enacted at the last session of the legislature providing for the employment of a State forester, the establishment of a forest fire protective system, and the acquisition and administration of State forests.

A study made in Florida in 1909 in cooperation with the State resulted during the year in the introduction of a bill in the State legislature to establish a State forest organization. Cooperative studies of loblolly pine in North Carolina and yellow poplar in Tennessee were completed.

The compilation of State forest land and fire laws has now been completed for 37 States and practically completed for 3 additional States. The purpose of this compilation is to keep the Forest Service in close touch with existing State forest legislation and to place it in a position to give advice and to further to the utmost the development of forest legislation within the States. Within the year material assistance of this kind was furnished to the State of Alabama.

A tax study in cooperation with the State of Washington was completed and efforts were made to secure its publication either by the State or by a private association. This, it is hoped, can be accomplished shortly.

COOPERATION WITH PRIVATE OWNERS.

The remarkable development of State forestry in the East and the increase in the number of private foresters has made it possible to restrict the scope of Federal cooperation when individual owners may obtain assistance from these sources. To make certain that the entire field is covered agreements concerning the part of the work which will be covered by the Federal Government and the part by the State organizations have been reached with Maine, New Hampshire, Vermont, Massachusetts, Rhode Island, Connecticut, New York, New Jersey, Pennsylvania, Maryland, North Carolina, Georgia, Indiana, Michigan, Wisconsin, Minnesota, Missouri, Ohio, Washington, California, Idaho, Nevada, Colorado, Nebraska, and Kansas. Applications for assistance and inquiries from these States are now referred to the State organization for necessary field examinations and detailed information. The service merely forwards available publications.

In States where field examinations are still made by the service because of the absence of any State agency prepared to handle the work, examinations have been mainly restricted to small holdings. Owners of larger tracts are generally referred to private or consulting foresters. For the sake of economy as well as to render the work of the largest educational value, the service endeavors to make several examinations in a locality at the same time. The reduction in this work makes it possible to devote more attention to an exceedingly important phase of cooperative work. It is believed that the maximum results can be secured with the least expenditures by issuing a series of regional publications giving detailed advice on woodlot management and forestation for the prevailing types of forests in the principal regions of the eastern United States. Several publications of this character are already available, and others are proposed. They will be of decided value to private owners for direct application in the management of their woodlands, as well as to State organizations and to consulting foresters.

There were made 13 woodland examinations for private owners, covering in all an area of 44,334 acres. Excluding three large tracts with a total area exceeding 42,000 acres, for which the examinations were arranged prior to the adoption of the policy not to examine large tracts, the average area of the tracts examined was 218.7 acres. For one large tract of approximately 40,000 acres in the mountains of Virginia and West Virginia the owner desired advice concerning the best method of fire protection. Nine of the tracts are located in Virginia and West Virginia, neither of which has a forestry department.

OTHER INVESTIGATIONS.

SILVICULTURAL AND DENDROLOGICAL STUDIES.

During the year commercial tree studies, covering the growth, volume, and yield of the tree, its utilization and life history, and the best methods of management to secure natural or artificial reproduction, were completed for balsam fir, cottonwood, second-growth yellow poplar, ashes, willows, loblolly pine in North Carolina, and eastern white pine. Similar studies of five other species are nearing completion. Besides their future usefulness in the management of National

Forests in the East, these studies are of immediate value to State foresters and to private owners of timberlands and wood lots.

Silvicultural studies necessarily involve the collection of a large number of field data and tree measurements. Aside from their use in the particular study for which they are gathered, these data and measurements, taken together, furnish material with which it is possible to establish laws and relationships of tree growth of the greatest value to those having to do with the study or management of timberlands. During the year 18,500 forest measurements and data were worked into 32 volume, 6 yield, 10 growth, and 430 stand tables, as well as into miscellaneous tables of other kinds. In answer to inquiries from lumbermen and other timberland owners, State and private foresters, and forest officers, 11,016 such tables were given out.

A study made of the results of forest planting by private owners in the northeastern States yielded valuable data on the amount of planting that has been done, methods followed, cost, and rate of growth and yield of the different species planted. On the poorer farm lands of the region forest planting is on the increase, and is being given considerable impetus by State aid. The movement is particularly noticeable in those States which contain, in the aggregate, large areas unsuitable for agriculture.

From data furnished for several years by volunteer observers throughout the country a tree calendar was prepared showing the time of leafing, ripening of fruit, falling of fruit, and falling of leaves for 60 species, including native trees and a few of the common exotics.

The investigations in basket-willow culture were further developed during the year. Experiments with both native and exotic willows at the Arlington farm of the Department of Agriculture produced several heretofore unknown varieties of exceptional promise. A part of the experimental work was transferred to Ames, Iowa, since it was found that Arlington was too far south for the best development of many of the native species. The first of a series of experiments in protecting river banks and lake shores from erosion by planting basket willows was begun on the shore of Lake Erie. Here the production of basket willows will be secondary to that of protecting valuable land from wave action. As in former years, willow cuttings from the Arlington farm were distributed to applicants, with advice concerning the best cultural methods. Approximately 80,500 cuttings were sent out, of which 20,000 went to agricultural experiment stations, 4,500 to forest schools, 5,500 to Forest Service nurseries, 30,000 for use in cooperative work in New Jersey, and 20,500 to individuals in 32 different States.

Dendrological studies of the distinguishing structural characteristics of important native trees, and of foreign woods for which inferior substitutes are likely to be placed upon the American market, yielded material on North American walnut and sycamore woods, Circassian walnut, and greenheart, which has been prepared for publication. Similar studies of North American pine and elm woods, true mahogany, rattan, and sandalwood were begun. In addition, monographs were prepared on the structural characteristics of balsam fir, red pine, and jack pine woods for use in silvicultural publications dealing with these species.

During the year a study was made of the pith-ray flecks, or medullary spots, which occur in many native woods. These are caused by the larvæ of an insect which live in the cambium during the growing season, and discolor the wood, often rendering it unfit for certain uses. The study dealt with the kinds of trees affected, the means by which the larvæ obtain entrance to the cambium, the geographical distribution of the insect and the factors affecting the local distribution of larvæ and mines, and the deteriorative effect on the wood.

Hand collections of the chief commercial woods of North America were prepared for the use of schools and of branches of the Forest Service needing such material. In cooperation with the Bureau of Plant Industry, 100 important Panama woods were described and illustrated for a proposed publication dealing with the trees and woods of the Isthmus. A catalogue of national forest flora was prepared, showing on which national forests certain species occur. The study of the effect of shade on hardiness of coniferous seedlings, begun in 1911, was continued. As in former years, a number of wood samples submitted by manufacturers and other wood users were identified.

STUDIES OF FOREST PRODUCTS.

Work in forest products during 1912 was of broader scope, greater volume, and productive of more important results than in any previous year.

STRENGTH TESTS.

The work of testing woods grown in the United States as a means of assisting users to select the species best adapted to a given purpose or to find substitutes for species becoming difficult to obtain was actively carried forward. During the year 23,882 tests were made on 35 species of wood. By the systematization of this work the cost of making tests has been steadily reduced, until now it amounts for each test to approximately 50 cents, or about half the cost prior to the establishment of the Forest Products Laboratory. The tests will be continued until all species of commercial importance growing in the United States have been covered.

The work in connection with structural timbers was confined during the year mainly to analyses of test data previously obtained for longleaf, shortleaf, and loblolly pine, Douglas fir, western hemlock, western larch, Norway pine, tamarack, and red spruce. One important result was to show that many of the defects which have been the basis of culling timbers do not seriously affect their value for structural purposes. Another fact brought out is that western hemlock, generally considered an inferior timber, is entitled to a place among the important western woods. Green western hemlock stringers showed an average strength 88 per cent as great as that of Douglas fir, one of the chief construction timbers of the United States. Western larch, another little-used wood, showed a strength 81.7 per cent of that of Douglas fir. Besides determining the relative mechanical properties of the different woods, the results of these tests permit the formulation of grading rules that classify timbers according to strength. Tests were started on western yellow-pine car sills and floor beams and were completed on that portion of the

material tested green. This series will conclude the tests on important structural woods of the Pacific Northwest.

Tests were made on standard 6-foot, 6-pin cross arms, divided into seven groups, as follows: Douglas fir; shortleaf pine, natural and creosoted; longleaf pine, 50, 75, and 100 per cent heart; and southern white cedar. Users of cross arms have been demanding the better grades and stronger kinds of timber. The tests indicate that for arms of the dimensions of those tested less consideration need be given to initial strength, and therefore a greater latitude can be exercised in the choice of woods.

The heavy loss incurred through damage to freight in transit has turned the attention of railways and shippers to the better construction of wooden containers. Tests of nailed, wire-bound, and dove-tailed packing boxes were undertaken in cooperation with the bureau for the safe transportation of explosives and other dangerous articles. The results of the tests were especially favorable to the wire-bound boxes. A practical effect of the tests has been the modification of regulations of the Interstate Commerce Commission and of specifications of the Navy Department in regard to boxes used for the transportation of explosives.

Throughout the Rocky Mountain region of Wyoming, Montana, and Colorado western red cedar, imported from Idaho, has been the chief wood used for poles. These three States, however, contain much fire-killed lodgepole pine and Engelmann spruce. To secure data on which a comparison of strength might be based, tests were made on the Idaho cedar and on the Rocky Mountain woods. Most of these were completed the previous year, but the work was extended to include air-seasoned lodgepole pine poles cut from green material. The results of the tests show that both the spruce and pine, when properly treated with preservatives, are suitable for poles. Their use for this purpose will lessen the cost of constructing telephone lines throughout a wide region.

The effect of preservative treatments on the strength of timber has never been fully determined. Strength tests of stringers treated with creosote by commercial processes have been in progress several years. When the tests on Douglas fir, treated by the boiling process, showed a decided weakening of the timber, it was thought probable that the strength would be restored by seasoning. This, however, did not prove to be the case. Air-seasoned (treated) stringers showed a strength very little above that of the treated stringers tested without seasoning. Small specimens will be treated and tested to determine what part of the treating process is responsible for the loss of strength, whether other species treated by the same process show the same loss, and whether Douglas fir treated with creosote by other processes is affected similarly to that treated by the boiling process.

PHYSICAL PROPERTIES AND STRUCTURE OF WOOD.

In connection with the study of structural qualities of the various woods, described in my last report, more than 650 permanent microscopic slides, representing 100 different species, were prepared during the year. A special study of the occurrence and significance of tyloses in wood was completed, and shows that these have an important bearing upon the absorption of preservatives.

A study was made of a number of different species to determine the specific gravity of the actual wood substance. Results obtained thus far show it to be from 1.5 to 1.6, the variation among species being comparatively small. There are indications, however, that it may be influenced by certain treatments.

In the tests to determine the specific heat of wood, the chief results of which were mentioned last year, a decided rise in temperature with the absorption of water by the wood was indicated, and other tests will be made to determine the extent and significance of this.

The study of physical properties is not confined to the projects just described. Information on such properties as specific gravity of the oven-dry wood and shrinkage was obtained in connection with the strength tests; transmission of moisture from the wood was necessarily taken into account in kiln-drying experiments, while special studies of the transmission of heat and pressure and of the permeability of woods were carried on in connection with wood-preservation work.

DRYING OF WOOD.

A new type of kiln, invented by Mr. H. D. Tiemann, a member of the laboratory staff, has proved a success experimentally, and two patents covering the principles of its operation were received in March. These patents were dedicated to the public. The efficiency of the method in commercial practice has been tested at Berkeley, Cal., and at the Madison laboratory. The kiln at Berkeley has been used to dry eucalyptus lumber. It was operated during the fall and winter with blue gum (*Eucalyptus globulus*) and manna gum (*Eucalyptus viminalis*), and worked admirably. A small number of excellent boards were turned out, the material having been dried from the green condition with practically no checking or honey-combing, a thing which so far as known has never before been accomplished. The practical impossibility, however, of obtaining green lumber from young trees which is neither warped, checked, nor curled makes it very doubtful whether trees of these two species under 30 or 40 years of age, such as constitute the greatest part of the present stand of eucalyptus in California, can profitably be converted into high-grade lumber. It seems probable, however, that other eucalypts of slower growth may produce valuable lumber in from 30 to 40 years, and experiments will be made with several of them if trees can be found sufficiently mature for the purpose.

The kiln at Madison is a small wooden one. A number of runs have been made with green wagon stock, chiefly of swamp-grown red and white oaks, and birch, with results that indicate a great possible saving over present practice by elimination of checking and reduction of the time required for drying. A third kiln, at Cairo, Ill., will be used for drying hickory vehicle stock.

A study of the drying of lumber at atmospheric pressure, carried on in the experimental kiln described last year, brought out the need in kiln operation for accurate control of humidity and temperature, combined with a large amount of air circulation. In connection with this study a humidity diagram was prepared for the use of dry-kiln operators in determining all conditions of humidity within the kiln. A field study of commercial practice in the kiln drying of Douglas fir and other northwest woods was made during the year.

WOOD PRESERVATION.

Studies made during the year in wood preservation dealt with (1) the preservative; (2) the wood, its penetrability and resistance to decay; and (3) methods of injection.

Results secured in an experiment with mine timbers in actual service showed that while untreated gangway sets have an average life of only from 1 to 2 years, the same timbers, when brush treated with coal tar, will last from 3 to 4 years, and when impregnated with zinc-chloride solution, or creosote, are, as a rule, entirely sound at the end of 4 years. Inspections made during the year of 8 test tracks, laid at various times since 1902 with treated and untreated ties, showed that with one exception all the treatments used have increased the durability of the ties over that of similar untreated material. The test tracks have not been in service long enough to permit of definite conclusions as to just how much the natural life of ties can be prolonged by treatment, but that it may in many cases be doubled, or even trebled, seems certain. Untreated loblolly pine and hemlock ties laid in Texas lasted only 1.5 years, while of those treated by the Burnett process over 70 per cent are still serviceable after 7 years.

Many new preservatives are either being proposed or marketed. A number of such preservatives were tested during the year, and their physical, chemical, and fungicidal properties, their penetrative qualities, and the inflammability of wood treated with them determined. While many gave little evidence of usefulness, a few were found which promise to be of value either in reducing the cost of treatment or in increasing its efficiency.

To determine by a quick method the comparative efficiency of various preservatives in preventing the growth of fungi, tests were made with pure cultures of fungi in specially prepared cultural media. Results so far secured are of special interest in showing for any given preservative the proportion necessary to prevent the growth of fungi.

Creosotes derived from different sources, or from tars produced by different methods or at different temperatures, vary in their physical and chemical properties and in their efficiency as wood preservatives. To study the extent of this variation, an examination of authentic samples of tars collected from various sources was begun. The work involves a great number of precise determinations, and probably another year will elapse before final results are obtained. These are expected to afford a rational basis for classifying creosotes in accordance with their chemical and physical properties.

The study of the relative efficiency of creosote fractions, begun last year, was continued and extended. The tests now comprise determinations of the efficiency of the various fractions in preventing attack by marine organisms, in preventing decay, and in preventing the absorption of water by paving blocks. A second set of pile sections, treated with lesser amounts of the various fractions than those placed the previous year, were set in the Gulf of Mexico and in San Francisco Bay. Data on the volatilization of various fractions of creosote after their injection into wood, secured in connection with this experiment, indicate that the creosote, to be of most value, at least for loblolly pine, should contain considerable quantities of

high boiling fractions, which appear to plug up the outer cells and so insure the retention of the lighter oils in the interior of the wood. In the paving-block tests preliminary results throw an interesting light on the relative efficiency of "heavy" and "light" oils in treating this class of material.

A perplexing problem in connection with the preservative treatment of ties is how to obtain a uniform treatment of all ties in any one cylinder charge: To accomplish this it is essential that only timbers which present the same degree of resistance to penetration be treated together. Tests to establish a scale of penetrability have been completed on a large number of coniferous woods and the results are now being analyzed. The work will be continued on woods of the broadleaf trees.

To determine the relative resistance of various untreated woods to decay, specimens were subjected to pure cultures of fungi in jars. The tests have not been under way long enough to give definite results.

To find a preservative treatment for poles used in the construction of telephone lines upon national forests which can be applied locally and at small cost, preliminary tests with the Boucherie process, which has been successfully used in Europe, were made on several national forests in California. This process consists, briefly, of impregnating freshly cut poles with a solution of copper sulphate, aided by the osmotic action of the wood cells. Experiments already made have been very encouraging, and more extensive ones have been undertaken. If the process is found to be feasible for this country it should find extensive use by commercial companies, especially in the more remote regions.

A series of tests to determine an economical method for treating paving blocks of Douglas fir and western hemlock, undertaken in cooperation with the University of Washington, showed that a cheap and efficient treatment can be obtained by the open-tank process. Preliminary tests on western larch blocks indicate that this species is adapted to the same method of treatment.

Experimental treatment of a large number of red oak and hard maple cross-ties, to determine the relative efficiency of different processes, was completed at the close of last year. The treated ties, together with a number of untreated ones—about 1,700 in all—have been laid in a test track of the Chicago, Milwaukee & St. Paul Railway Co., in cooperation with which the work was undertaken. Inspections of the test track will be made at least once each year to determine the condition of the ties in respect to decay and rail wear.

Exact knowledge concerning the preliminary vacuum or pressure, the rate at which heat is transmitted to the interior of the wood from the surrounding medium, and the manner in which a liquid permeates wood must be had before any real advance in methods of impregnating woods can be expected. Studies were therefore made during the year of the rate at which air pressure or vacuum is transmitted through wood and the effect of preliminary vacuum or pressure upon absorption and penetration of the preservative, the recovery of the preservative after injection, and the loss after treatment by dripping and volatilization. Other studies dealt with the relation of certain structural features, such as tyloses, resin canals, and bordered pits, to permeability of the wood.

The treating plant of the Oregon Agricultural College was operated by a service representative for a week during a special short course, and the service assisted in the installation of a small open-tank plant for the University of Colorado.

WOOD DISTILLATION.

The results of studies dealing with the analysis, refining, and composition of wood turpentine, concluded during the year, may be summarized briefly as: (1) A new distillation method by which more complete and accurate conclusions in regard to the composition of a turpentine can be drawn than is possible with former methods of equal simplicity; (2) refining of five samples of crude wood turpentine produced by different commercial processes, and the description of methods of refining applicable to wood turpentine of a wide range in composition; (3) data which show how the composition of wood turpentine is influenced by different methods of production, by refining, by storage, and how wood turpentine compare with gum turpentine in composition; and (4) the presentation in specific form for the first time of the differences in composition between gum and wood turpentine, and between different samples of wood turpentine, and the reasons therefor.

Experiments on the steam extraction of volatile oils from resinous woods were completed. The effect of size of chip, steam pressure, and speed of distillation on the yield of oil and efficiency of the process were determined. With a knowledge of the various factors of cost at any steam distillation plant it will be possible from the results of the experiments to decide readily on the most economical conditions for conducting distillation.

Attempts to distill commercially resinous woods of the Northwest, particularly Douglas fir, have not proved entirely successful. At the beginning of the year the Forest Service entered into an agreement with the University of Washington by which cooperative experiments will be carried on to determine the best methods of distillation and refining, the distillation methods applicable to Douglas fir and other woods of the Northwest, the yield of distillates from the various species, and the possibilities of their commercial use. Some work has already been done, but no definite results have as yet been secured.

The hardwood distillation industry has operated upon beech, birch, and maple almost exclusively. Experiments were undertaken to determine the comparative yield of valuable products of a number of other species. As compared with average yields per cord of 8.6, 11.4, and 11.7 gallons of wood alcohol, respectively, for birch, beech, and maple, chestnut yielded 3.6, red gum 9.2, oak 9.2, and hickory 15.3 gallons. In acetate of lime, as compared with average yields per cord of 349, 318, and 292 pounds, respectively, for birch, beech, and maple, chestnut yielded 195, red gum 258, oak 300, and hickory 338 pounds.

Because it seemed probable that a larger yield of valuable distillation products than is now obtained by commercial plants could be secured, a study of methods of distillation has been planned. Very little experimental work has as yet been done, though incidentally, in the determinations of yields from various species, the yield of

acetic acid was found to be about 50 per cent greater than that obtained commercially. The reason for this increased yield is not yet known.

With a view to reducing the cost of hardwood distillation, and at the same time extracting more refined products, the effect of repeated distillations of alcohol with and without alkalies and the neutralization of acetic acid with some agent less caustic than calcium oxide were studied. It appears that the acid vapor may be treated with calcium carbonate in such a manner as to secure a calcium acetate of a high degree of refinement, and at the same time separate the alcohol liquors in one distillation, instead of in two, as heretofore required.

Extraction experiments are being made on the leaves of various conifers of the Pacific coast. The yields of commercially valuable oil thus far secured, however, are so small that it is doubtful whether the extraction can be conducted profitably by a commercial plant. Experiments will be continued until more definite results are obtained.

One of the most promising means for profitably utilizing wood waste is the production of ethyl alcohol. To ascertain whether the production of ethyl alcohol from sawdust is commercially feasible, and, if so, what are the best methods of procedure, apparatus is being installed at the laboratory for conducting experiments on a large scale.

NAVAL STORES.

Experiments in the tapping of western species for the production of naval stores, begun in 1910, were continued on a more extensive scale. During the turpentine season of 1911 systematic experiments were conducted on western yellow pine in Arizona, and on both western yellow pine and piñon pine in Colorado. The flow from digger and Jeffrey pine in California is being studied the present season. The results of the Arizona and Colorado experiments were described last year. Since then oleoresins obtained from the various species in the tapping experiments have been subjected to a thorough analysis. Of the oils examined, that from western yellow pine from Arizona conforms most nearly to ordinary turpentine, and it is likely that both the California and Arizona oils will serve the purposes for which ordinary turpentine is commonly used.

WOOD PULP AND PAPER.

Results from experiments with jack pine and hemlock for ground wood pulp, begun last year, have demonstrated conclusively that these two woods can be made into the cheaper grades of paper by practically the same methods used in grinding spruce pulp. Since the results of the tests have become known at least one mill has begun grinding these woods. A number of other species which are available for use as pulp wood are now being studied.

Practice among mills manufacturing ground wood pulp differs widely, even when the same species of wood are used and the same products turned out. With this in mind, a thorough study was made of the effects of the condition of the surface of the pulp stone, the pressure with which wood is forced upon the stone, the tempera-

ture of grinding, and the physical condition of the wood upon the resultant factors of the horsepower which must be applied to the grinder, the amount of pulp produced in 24 hours, the horsepower consumption per ton of pulp, and the yield and quality of the pulp. The results should be of great value to the industry in establishing standards of practice, increasing the efficiency of grinding, and reducing the cost of operation.

The effect of steaming or boiling wood previous to grinding was determined in part during the year. It was found that such treatment produces a pulp of greatly increased strength, though of a darker color. It is possible that woods not suitable for grinding in their natural state may be rendered suitable by some preliminary treatment, and that the ground wood pulp thus obtained can be used for tough wrapping papers which now require chemical pulps.

In the tests to determine the relative suitability of various species for the production of soda and sulphite pulps, redwood, redwood bark, red fir (*Abies magnifica*), lodgepole pine, and sand pine were studied. In addition, a small quantity of mill waste from Mexico (consisting mostly of *Pinus ponderosa*) was tested at the request of the State Department. The yields from the best cooks of these materials ranged, in the soda process, from 34.9 per cent for redwood bark to 51.7 for the mill waste, and in the sulphite process from 33 per cent for redwood bark to 47.8 per cent for sand pine.

The general effect of the work with soda and sulphite pulps from the various woods is seen in the increasing use by pulp mills of species which a few years ago were not thought suitable for the commercial manufacture of paper pulp.

There is reason to believe that the efficiency of commercial practice, as well as of experimental work by the service, may be increased by a knowledge of the relation of the fundamental cooking conditions in pulp manufacture. The effects of the variable cooking conditions—proportion of caustic soda to weight of wood, causticity of cooking liquor, and temperature and duration of cooking—in the production of soda pulp have been studied, and the relation of these factors to the yield of crude and screened pulps, the consumption of chemicals, and the quality of the resultant pulps determined. Similar experiments have been begun with the sulphite and sulphate processes, using several species of wood.

WOOD UTILIZATION.

Douglas fir, probably the most important timber tree of the Northwest, has often been a prey to forest fires, which have left immense quantities of dead standing timber. A study of such timber, made to determine its rate of deterioration, usability, and strength, was completed during the year. It showed that fire-killed trees under 3 feet in diameter usually remain merchantable for 8 or 10 years, while larger trees with thin sapwood may remain merchantable for 15 or 20 years. The strength of the dead timber was found to be but slightly below that of green material, thus indicating that the sound wood from fire-killed trees may safely be used for general construction purposes.

A study of the production and consumption of the paper products in the Pacific Northwest was completed. The results should prove

of assistance to the Forest Service and to private timberland owners in the disposal of certain species of trees not in demand for lumber.

Western red cedar supplies the material for 65 per cent of the shingles produced in the United States. The manufacture of such shingles is confined almost entirely to the State of Washington, where it forms a very important industry. A study of this industry, begun in 1911, was completed during this year.

Another study dealt with the industries which use the products of wood distillation, especial attention being given to the proportion of the products used by each.

The cooperative work between the Forest Service and the Bureau of the Census in collecting and compiling statistics of forest products of the United States was continued during the year. The statistics gathered annually now cover lumber, lath, shingles, cross-ties, pulp wood, slack and tight cooperage, veneer, poles, cross arms, brackets, insulator pins, excelsior, and wood distillation, while figures for consumption of tanbark and tanning extract, turpentine and rosin, and mine timbers are secured every five years. In addition, statistics relating to wood preservation are gathered annually by the Forest Service.

Wholesale lumber prices, f. o. b. market and f. o. b. mill, were collected and issued quarterly, as in the previous year. These furnish a continuous and permanent record of the rise and fall of lumber values.

Wood-using industry studies, which show the kinds and amount of wood required by the various industries, the purposes for which the different species are employed, and the extent of their use, were completed in Alabama, Arkansas, California, Illinois, Louisiana, Michigan, Mississippi, Missouri, Tennessee, Texas, and Washington. Field work was completed for similar studies in Connecticut, Florida, Georgia, Idaho, Iowa, Kansas, Maine, Minnesota, Montana, Nebraska, New Hampshire, North Dakota, Oklahoma, Rhode Island, South Dakota, Vermont, and Virginia. When all States have been covered it is planned to issue the results in two series of publications—one to give the uses to which the important commercial woods of the United States are put, the other to discuss the requirements and the methods of manufacture employed by the wood-using industries.

MISCELLANEOUS.

During the year the Forest Service issued 44 new publications as against 31 the year before. Revisions of three older publications were also issued. The total number of Forest Service publications distributed was 359,129 as compared with 245,500 in the previous year. Most of the bulletins and circulars were of a technical character, presenting the results of investigative work. Besides the publications issued there were 17 new bulletins and circulars in press at the end of the year.

One thousand and fifty-four books and pamphlets, most of them free publications received either directly by the Forest Service or through the library of the department, were added to the library of the Washington office, bringing the total number of volumes there up to 16,017. Sixty forest and trade journals, about half of which are secured free and half purchased by the department, are regularly received at Washington.

There were added to libraries maintained in supervisors' and district offices, the Forest Products Laboratory, and the Office of Wood Utilization at Chicago 2,894 books and pamphlets, bringing the total number of volumes in these libraries up to 20,827. The amount spent for the purchase of books for field libraries during the year was \$2,600.

A bibliography of books on forestry in the Department of Agriculture, prepared by the department library and classified by the Forest Service, was issued during the year.

There are now 29,133 classified and tabulated photographs in the collection, 4,053 of which were added during the year.

More than 3,000 microsections of native and foreign species were added to the collection, which is used in the study of the structural characters of wood and in the identification of wood samples. About 6,500 microsections are now available.

The reference collection of native and foreign woods was enlarged during the year by the addition of 750 specimens, of which more than 150 were commercial woods from Panama, secured through co-operation with the Bureau of Plant Industry. The entire collection now includes about 6,800 specimens. About 400 specimens were added to the forest herbarium, which now contains 5,400 reference specimens, and approximately 1,000 tree-range records were added to those on file. Sixteen new maps, showing the distribution of different tree species, were prepared.

Members of the Forest Service delivered 185 public addresses during the year, mainly in response to requests from educational institutions and associations of lumbermen or lumber manufacturers. In addition, about 50 informal addresses were made to stockmen and other users of the national forests. Exhibits were made at the Spokane Interstate Fair, Spokane, Wash.; Oregon State Fair, Salem, Oreg.; Walla Walla County Fair, Walla Walla, Wash.; Arkansas-Oklahoma Fair, Hot Springs, Ark.; Southern Commercial Congress Exhibit, Washington, D. C.; Appalachian Exposition, Knoxville, Tenn.; National Land and Irrigation Exposition, Pittsburgh, Pa.; Maryland Week Exposition, Baltimore, Md.; Insular Fair, San Juan, P. R.; Pacific Land and Products Exposition, Los Angeles, Cal.; Washington Academy of Science Exhibit, Washington, D. C.; and Boy Scouts' Exhibit, New York City. One of these exhibits was supplemented by explanatory lectures. All expenses for transportation and installation of material and for travel and subsistence involved in making the exhibits was borne by the exposition authorities, except in the case of the National Land and Irrigation Exposition, which went into bankruptcy, making it necessary for the Forest Service to pay a portion of the cost of securing the return of its material to Washington. The greater part of the matter exhibited, consisting of bromide enlargements, transparencies, maps, and charts, was material left on hand from previous expositions.

WORK FOR THE ENSUING YEAR.

Work for the ensuing year will follow in the main the same lines as that of the past year. The scope of many projects will be broadened, certain closely related lines of work will be taken up, and every effort will be made to bring to completion such work as can be accomplished in a comparatively short time. So many of the investigations and

experiments described in the body of this report must of necessity extend over more than one year that specific mention of a number still under way will not be made.

The classification, survey, and listing of national forest lands chiefly valuable for agriculture, provided for in the appropriation act of August 10, 1912, will be begun. Men well qualified by training and experience will be selected to have direct supervision over the work, to which they will give their entire time and attention. Experts from the Bureau of Soils will assist in the classification. Field examinations will be detailed and thorough, and will take into account all factors, such as climate, topography, soil, stand of merchantable timber, and value for purposes other than agriculture, influencing the comparative values of the lands examined. Parties have already been organized and are proceeding with the work on eight forests. This work will be extended to other forests as rapidly as men are available. Effort will be made to sell the stumpage on agricultural lands listed as temporarily more valuable for timber, in order that these lands may as soon as possible be opened to entry. The great area to be classified and the necessity for thorough and painstaking examinations will necessarily cause the work to be extended over several years. It will, however, in no way interfere with the regular handling of applications for homesteads under the act of June 11, 1906.

The work of preparing detailed fire plans for the national forests will be carried forward as rapidly as possible. Along with this will go further study of effective means of locating and reporting fires and of how to use the small protective force to the best advantage. Lookout stations will be established and equipped, trails and telephone lines constructed, and fire-fighting equipment purchased to the extent that funds permit. A great deal of attention will be given to the problem of bringing home to the public the necessity of cooperating with the service in the prevention and suppression of forest fires.

In conformity with the plans outlined in the body of this report, effort will be made during the year to bring the total amount of timber sold as nearly as possible up to 3,000,000,000 feet. As one of the means of accomplishing this, improvement will be sought in methods of advertising and in otherwise bringing available timber to the attention of prospective purchasers. Particular attention will be given during the year to the development of a policy for large sales that will be practical from the standpoint of the lumberman and that will at the same time insure protection to the interests of the United States. A modification of the timber-sale policy regarding small sales will be made necessary by the provision in the agricultural appropriation act for the fiscal year 1913, which directs the Secretary of Agriculture to sell at actual cost to homestead settlers and farmers, for their domestic use, the mature dead and down timber in national forests. Heretofore the law has provided that sales of national forest timber not exceeding \$100 should be made at its appraised value, and that timber of value exceeding \$100 should be advertised for at least 30 days and disposed of to the highest bidder. Under the present amendment timber desired by homestead settlers and farmers for their own use will be sold to them without advertising at a price based upon the cost per thousand feet of making and administering such sales.

Preparation of working plans as a means of systematizing and placing upon a definite, clean-cut basis the management of the different forests will be continued. Forests where the use of one or more resources is very intensive, or promises to be in the near future, will be given first attention. Preliminary plans will be prepared for all forests as rapidly as possible. As a basis for the work, timber reconnoissance will be extended to cover as many new forests as the force and money available will permit.

During the winter the central investigative committee will meet, and, with the recommendations of the various district committees before them, will pass upon plans for investigative work of the entire service during the following season.

As indicated in the body of this report, reforestation work during the coming year will be confined to experimental studies and to the reforestation of approximately 30,000 acres, or as near that area as available funds will permit. As a result of the work carried on during the past year, experiments in reforestation will be conducted with a more definite idea of the lines along which the work should be concentrated. In the actual reforestation it will be possible to devote much attention to perfecting methods to secure better results in large operations and to reduce costs.

The establishment of local experiment stations on national forests has been so fruitful of results that the system will be extended to include additional forest types and regions in the Northwest. In studies at the experiment stations special emphasis will be laid on methods of cutting the different types of forest to secure natural reproduction. The general study of forest types and the physical factors which determine them will be continued. The study of the relation of forest cover to streamflow now being made at the Wagon-wheel Gap Station in the Rockies will, in all likelihood, be extended to the Southern Appalachians. During the coming year the timber on one of the two watersheds at Wagon Wheel Gap will be cut and sold and the slash burned. This will give for the first time an opportunity to compare the regimen of streams from protected and unprotected watersheds, the difference between which was definitely established before any change in their surface cover took place. In cooperation with the University of Wisconsin, problems relating to the forests of Michigan, Minnesota, and Wisconsin will be studied at the experiment station at Cloquet, Wis.

Much attention will be given during the year to problems of forest mensuration. In the past, work along this line included only the collection and tabulation of field measurements on growth, volume, and yield of trees. A large amount of the data thus far collected will be analyzed during the coming year and an attempt made to establish general laws of tree growth.

The grazing reconnoissance on the Coconino, Tusayan, Targhee, Manti, Medicine Bow, and Minam Forests will be completed, and the work extended to others. General grazing studies will include collection, identification, and determination of the economic value of approximately 6,000 specimens of range plants; means of securing natural revegetation of depleted lands by alternation in the use of ranges; methods of handling stock by which waste and damage may be minimized, fire danger reduced, new ranges utilized, and the stock improved; and methods of developing water for stock upon

arid ranges. More intensive investigations will include the effect of overgrazing upon stream flow, erosion, and forest reproduction, and the possibilities of artificial reseeding and of growing seed for regeneration of ranges. In connection with the grazing studies, an experiment station has been established on the Manti National Forest, known as the Utah Experiment Station, where special stress will be laid on investigations relating to the effect of grass cover and grazing upon floods, erosion, and purity of water supply.

Cooperation with the States in fire protection under the Weeks law will be continued, and the benefits of the act extended to as many new States as possible. A meeting of State officials will be held in order to arrive at the best policy and method of protection. Inspection will be made by the Forest Service to insure that the money appropriated among the various States is being properly expended. To continue the cooperative work beyond the close of the calendar year 1912 an additional appropriation under the same terms as the first one will be needed.

WORK FOR THE YEAR 1914.

Broadly speaking, the work of the Forest Service in 1914 will deal with the same general problems that have confronted it in recent years. As progress is made along the different lines of work new fields for study and investigation present themselves. The development of methods suitable to one region perhaps calls for the development of other and wholly different methods for another one. With the steadily increasing use of the national forests new problems, which must be met and solved, constantly arise in connection with their management.

One important extension of work in 1914 will be in connection with the new national forests in the East. By the beginning of the fiscal year title to some 500,000 acres of land in the Appalachian and White Mountains probably will have passed to the Government, and this area and additional areas acquired during the year will be put under administration. Since these forests are in the center of a region of large population their use should be intensive from the first. To handle the investigative problems in connection with management of the eastern forests, experiment stations will, if funds are available, be established to conduct studies in the different forest types. Adequate means of fire protection suitable to the region will be developed and preliminary work done in the reforestation of denuded lands.

The work of classifying national forest lands, as provided for in the act of August 10, 1912, will be continued through the year, and every effort will be made to bring the work as far toward completion as possible.

During the year results of the policy of making large timber sales should become manifest in a greatly increased cutting of national forest timber. Reforestation to about the same extent as in the previous two years will be continued, but, guided by past investigations and results, with improved methods and, it is hoped, at lower cost. Working plans for some of the forests whose resources are intensively used will be brought to completion and substantial progress made toward the completion of preliminary plans for all for-

ests. If funds are available the system of experiment stations will in all likelihood be further extended to cover additional forest types in the West.

Grazing reconnoissance will be extended to a number of new forests. Studies in connection with the effects of grazing upon stream flow, erosion, and forest reproduction, reseeding of range areas, revegetation of depleted lands, and of various methods of handling stock will be further developed.

Cooperation with the States in fire protection will be carried forward if a further appropriation is provided for that purpose. On the national forests the work of preparing detailed fire plans and of devising means of adequate fire protection will continue to receive the attention that the urgency of the problem demands.



